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ABSTRACT

The report of the ad-hoc panel and the 25 papers in these proceedings cover a wide spectrum of issues and perspectives relating to information systems, services, and networks at both the national and international levels. The first part of this six-part volume presents the panel's report, which reviews the history of the panel and its purpose and summarizes its considerations of concepts and issues; the existing situation and needs of national information systems; the impact of trends in information collection, processing, and dissemination; the nature of information requirements; and international linkages and the establishment of a global information network. The second part includes three papers on concepts and issues, terminology definitions, and an overview of issues relating to a United Nations global referral network. The 11 papers in the third section provide a broad view of the status of scientific and technical information activities in developing countries and descriptions of national and regional experiences in Egypt, Jamaica, India, Hungary, Honduras, the Socialist Republic of Romania, Kuwait, Ghana, Mexico, and Africa. Part 4 includes four papers which examine problems and trends, including constraints on the flow of scientific and technological information, availability of U.S. public and private databases and services in developing countries, development of an information infrastructure, and low-cost satellite communications. The fifth part includes two papers: one on priorities in a global network and the other on problems and prospects of networking in technological information in Asia and the Pacific. The final part provides five descriptions of experiences of the organizations of the United Nations system and other institutions. Lists of panel participants and abbreviations are appended. (THC)

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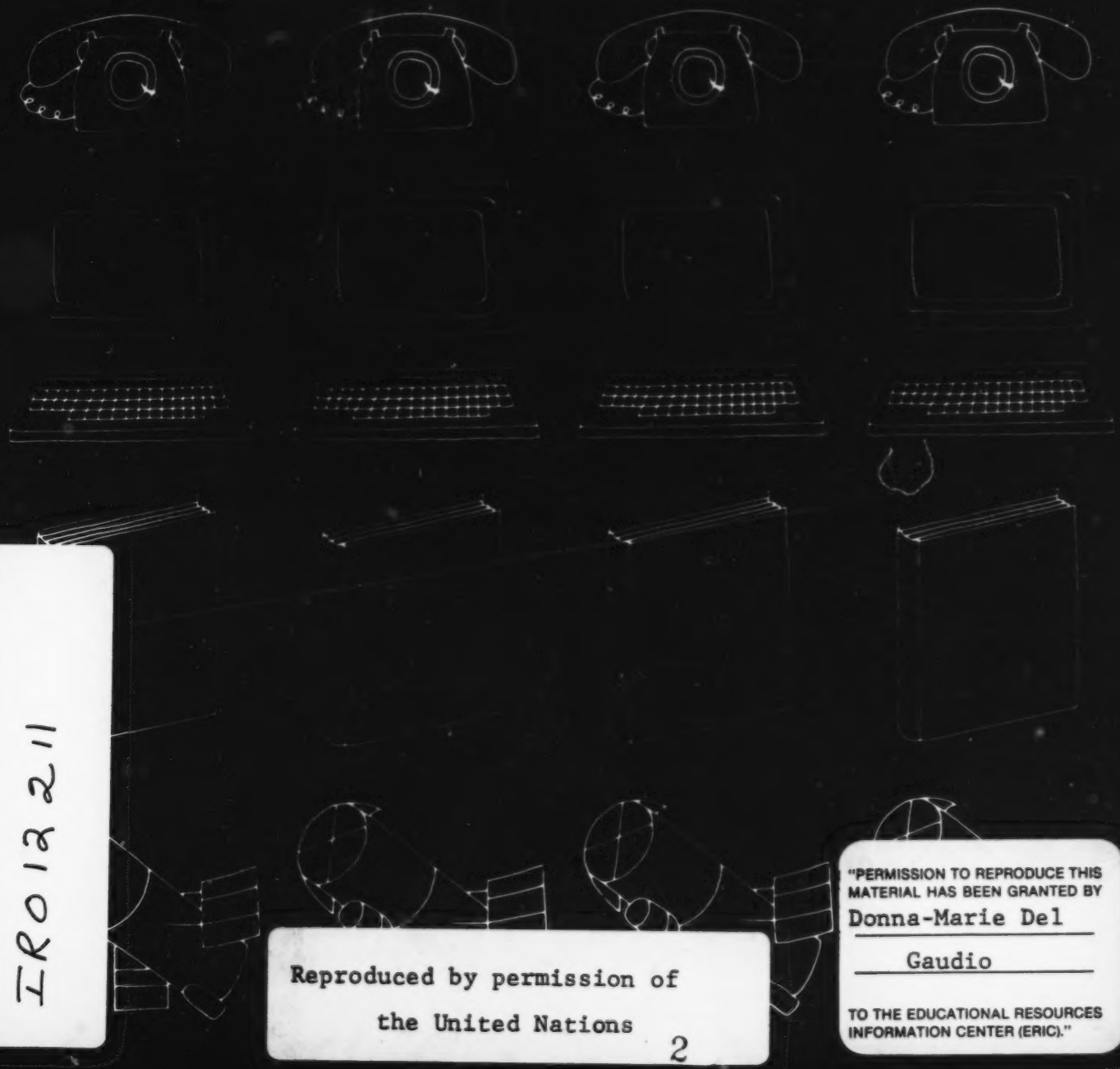
SCIENTIFIC AND TECHNOLOGICAL INFORMATION FOR DEVELOPMENT



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Scientific and Technological Information for Development

Proceedings of the Ad-hoc Panel of Experts on Information Systems for Science and Technology for Development

held in Rome, Italy
21-25 January 1985

UNITED NATIONS
New York, 1985

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Foreword

Thousands of scientific and technical publications of all kinds in a wide number of subjects are issued daily throughout the world. Their dramatic increase in recent years is due to the worldwide expansion of education and research, and to the development of new information technologies. However, all this information can be useful only if the end-users for whom it is intended know of its existence and are prepared to utilize it. Unfortunately, this is not always the case, particularly in developing countries. In fact, only a small proportion of scientific and technical publications and articles are available to them. It may often happen that information contained in one of these publications provides the answer needed to solve a problem in a different part of the world.

The collection, processing, storage, retrieval and dissemination of scientific and technical information within national boundaries and through international channels is a highly complex, diversified and expensive activity.

Because sound economic and social development decisions depend on the availability of information, which in turn depend on a wide array of technologies and related tools, developing countries must acquire the capabilities and resources needed to perform all these functions, in order to generate and utilize scientific and technical information relevant to their development process.

It was to assist developing countries in coping with this challenge that the United Nations Conference on Science and Technology for Development, held in Vienna in August 1979, adopted numerous recommendations relating to the development of scientific and technological information systems in these countries.

The recommendations of the Vienna Programme of Action addressed the following four main elements:

(i) Development of national scientific and technological information policies;

(ii) Establishing or strengthening material infrastructure to facilitate the availability of and access to information sources;

(iii) Promoting the utilization of scientific and technological information for national development; and

(iv) Establishment of a global network for the exchange of scientific and technological information.

The Intergovernmental Committee on Science and Technology for Development, established by the United Nations General Assembly to promote and oversee the implementation of the Vienna Programme of Action, elaborated these recommendations in an Operational Plan, where specific activities have been identified, in order to bring the subject matter into sharper focus and to provide a framework for co-operative international efforts.

The Intergovernmental Committee, at its fifth session in June 1983, requested the Centre for Science and Technology for Development, in co-operation with the Advisory Committee on Science and Technology for Development (ACSTD), the Task Force on Science and Technology for Development of the Administrative Committee on Co-ordination (ACC) and other intergovernmental institutions in the field of scientific and technical information, to prepare a study on the long-term plan of action for the establishment of the global scientific and technological information network to be submitted to the Committee at its seventh session in May-June 1985.

Such a global network was meant as a means of strengthening the existing system and services, at all levels, and of providing, through a shared knowledge of the operations of all participating organizations and institutions, the means for their intercommunication and linkage. It should be hospitable to a variety of scientific and technical information sources and services, the extent of which should be determined by user requirements.

More recently, the Intergovernmental Committee, at its sixth session (May-June 1984), decided to select information systems for science and technology for development as the first substantive theme to be examined, also during its next session in 1985, within a selective, in-depth, topical method of work adopted then. This panel has been convened as one of the main elements in the preparatory process for the seventh session of the Intergovernmental Committee. Therefore, its agenda encompassed the consideration of existing situations and needs of developing countries as well as the examination of options and possibilities of assisting them in developing their own capabilities in scientific and technological information, including through international linkages.

The collection of ideas and experiences presented by the authors in these papers would be invaluable to Member States, organizations of the United Nations system and all those interested in contributing to the implementation of the Vienna Programme of Action in general and in assisting developing countries in the development of their information systems for science and technology in particular.

I wish to take this opportunity to thank the Government of Italy for their support in organizing the Panel. In particular, my sincere thanks go to the Istituto di Studi sulla Ricerca e Documentazione Scientifica (ISRDS) of the Consiglio Nazionale delle Richerche (CNR) and to the Comitato Nazionale dell'Energia Nuclear e delle Energie Alternative (ENEA) for hosting the Panel and for providing the financial assistance which made the publication of this volume possible. I am grateful to the participants for contributing the papers contained in this volume. I am deeply appreciative of the hard work and enthusiasm of the staff of the Centre. In particular I wish to thank Mr. Kwaku Aning, Mr. Phactul Rego, Mr. M. Anandakrishnan and Mr. Rana Singh for their efforts, which ensured the successful organization of the Panel and the publication of this volume. I also deeply appreciate the dedication and diligence shown by Mrs. Dorothy

Perricone, Mrs. Colleen Louis, Mrs. Maria Elena Bly, and Ms. Elizabeth Pantaleon in providing the secretarial assistance in the preparation of this volume.

It is my ardent hope that this volume will be instrumental in increasing national awareness and goodwill in the international community to bring about the co-operation needed to help developing countries to strengthen their endogenous capabilities in this critical field and to be able to harness this important resource to aid their development efforts.

AMILCAR F. FERRARI
Executive Director
Centre for Science and Technology
for Development
United Nations, New York

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Introduction

So much has been written and said about scientific and technological information being a vital resource, that one tends to feel that drawing attention to its important role in development has become a mere cliché. However, a closer scrutiny of its impact in developing countries reveals that little has been done to enhance such role and that the implications of science and technology information are either not well understood, or taken for granted. It is, therefore, necessary to often remind ourselves about the meaning of it all.

Scientific and technological information is central to economic and social progress, both for the generation of new knowledge and for its application in the process of development. The effective use of this resource is an essential ingredient for the maximization of the impact of science and technology in developing countries.

Quite naturally, scientific and technological information in the development process was a central concern at the United Nations Conference on Science and Technology for Development, held in 1979 in Vienna. Among the issues dealt with in the adopted programme of action were the need for developing countries to formulate and adopt national information policies as integral parts of their overall national development plans, strengthen and coordinate agricultural and industrial extension services, develop and improve library services and use mass media to popularize science and technology. The Vienna Programme of Action recognized that developing countries should urgently develop and strengthen their information infrastructure to enable them to take advantage of the vast pool of information existing in developed as well as developing countries. In this regard, no state, especially developing countries, can afford, in terms of human and other resources, to become totally self-reliant in science and technology and their social and economic application. Thus interdependence in scientific and technological information between developed and developing countries, on one hand, and between developing countries themselves, on the other, is a key element to be taken into account in devising the strategy for faster development of the less developed. Consequently, the conference also recommended the establishment of a global network of scientific and technological information, as a tool to ensure an effective and intensive coupling of problem solvers and information services both in the developing south as well as the developed north. When the Intergovernmental Committee on Science and Technology for Development of the UN General Assembly decided to select the theme of information systems for science and technology for development for in-depth discussion at its seventh session from 28 May to 7 June 1985, it invited the advisory Committee on Science and Technology for Development to assist it in carrying out the necessary review of the state-of-the-art and, if any, of changing trends. In response to this request the Advisory Committee on Science and Technology for Development, in cooperation with the Government of Italy and the Istituto di Studi sulla Ricerca e la Documentazione Scientifica of the Consiglio Nazionale delle Ricerche organized the *ad-hoc* panel of experts on information systems for science and technology for development. A forum such as this would provide the practitioners of the art the opportunity to examine the pertinent issues and to contribute their views and experience in this important subject.

This volume is based largely on papers which were submitted to the *ad-hoc* panel of experts on information systems for science and technology for development. They cover a wide spectrum of issues and encompass many different perspectives, in considering concepts and practices relating to information systems, services and networks, both at national and international levels. Its publication aims not only at providing the Intergovernmental Committee with pertinent background material for its deliberations on the matter but also at widely disseminating it for the benefit of all interested parties, among them, government officials, information specialists, and last, but indeed not least, the information users.

This is precisely one of the aspects of the question widely and consistently emphasized here: it is not only the supply side of the equation which must be taken care of. Rather, the end user of scientific and technological information must be at the centre of the attention, if the systems and networks to be developed or strengthened are to produce the intended impact. Their ultimate purpose is to render useful services and this will be possible only, as demonstrated here, if users' real needs and conditions are fully taken into account. In this connection, the evidence presented in this volume stresses the distinctions between requirements of users of scientific information, on one hand, and technological information, on the other.

The rapid advances in information and communication technologies in the industrialized north, since the Vienna Conference, are leading the world into a society dominated by information, and the time when the exchange of information through the electronic medium rather than print-on-paper will be the norm rather than the exception may come soon. The urgency has thus become even more critical for improving developing countries' capabilities in this critical field. I wish to express my gratitude for all those who contributed their ideas and efforts for the fruitful discussion held in Rome, particularly my fellow members of the Advisory Committee, Professor Essam El-Din Galal and Dr. Manlio Martinez, who acted as Vice-Chairmen. In a very special way to Professor Galal, who conducted most of the hard work performed with wisdom and leadership, quite successfully.

PROF. UMBERTO COLOMBO
Chairman,
Advisory Committee on
Science and Technology for Development

Views of the Advisory Committee on Science and Technology for Development

(Extract from the report of the Advisory Committee on its fifth session, A/CN-11/59, February 1985)

Towards a global information network for science and technology for development

In response to the request of the Intergovernmental Committee, the Advisory Committee discussed the ways and means available to the international community to create a global information network as defined in the Vienna Programme of Action and has come to four general conclusions:

(a) Adequate national efforts in the area of scientific and technological information represent the essential base upon which any network might be built; without this the users, whose needs such a network should serve, would be isolated from the network;

(b) Each developing country needs to have some fundamental minimum of information available in primary form to allow it to sustain scientific and technological activities related to its own development; urgent, special efforts are needed to ensure that this becomes the case;

(c) At the international level, efforts should first be devoted to developing a global referral service which would enable national systems to locate relevant information sources wherever they are located;

(d) Such an international referral network should act in a manner which avoids duplication of existing services and which seeks to ensure that adequate linkages are provided among existing systems and services.

In what follows, the Advisory Committee will set out the key elements of the reasoning which led it to these conclusions. The Committee recognizes the high priority and urgency of improving the accessibility to developing countries of scientific and technological information. This urgency should also be seen in the context of the already progressing information revolution, which is changing policy-making, services and production activities. No country will remain unaffected.

Developing countries comprise a very diverse and heterogeneous group, at various levels of socio-economic development, and have varying priorities. Consequently, their information needs differ in terms of content and sectoral priorities, as do their resources and policies. This multiplicity of situations and needs makes it clear that the requirements of developing countries for scientific and technological information are extremely complex and varied and, by necessity, will cover a wide spectrum, particularly when the multitude of end-users is considered.

The Advisory Committee recognized that the requisite institutional service resources for providing access to scientific and technological information were generally inadequate in many developing countries and were far short of meeting the requirements of many important end-users. In addition, collection, processing, storage and dissemination of endogenous information were not well organized. The Advisory Committee, therefore, emphasized, first and foremost, the building up of national capabilities and infrastructure to ensure the utilization of accessible information by the relevant end-users. In order that scientific and technological information can add to national development capabilities, the needs of such end-users as Governments, research and development establishments, the productive sector, professionals and individual entrepreneurs in the different sectors and geographical locations, including the rural regions, must be met. Intersectoral linkages and intrasectoral dissemination will often need special provisions. The importance of a working network of communication, not only with the outside world but also at the national level, is of course a necessity. In addition, the dissemination process for small end-users requires specialized extension services that can deal with language problems and can transmit information in repackaged and utilizable form.

The upgrading of national infrastructures and their integration within a global network of services necessitate an international commitment to multilateral and bilateral assistance and co-operation with developing countries. The political will of Governments and their commitment to set high priority on scientific and technological information, to provide needed domestic resources, and to develop channels of co-operation among themselves will all be important contributions of developing countries.

Traditional means of dissemination of scientific and technological information will continue to play an important role in developing countries, and there is an obvious need to initiate international and national programmes to supplement these means and to sustain them at a contemporary and effective level. However, the Advisory Committee recognized that global trends would inevitably make new and advanced technologies like computers and telecommunications essential elements of any scientific and technological information system. The appropriate mix of traditional and advanced information technologies must be decided at the national level in accordance with national requirements. It is necessary for all developing countries to acquire the capabilities and to initiate the infrastructure for these new technologies in order to ensure linkage with international systems and to prepare for the inevitable time when much scientific and technological information will be available in an effective manner only through these means. The cost factor for a full modernization is an

important consideration, but recent developments are reducing these costs, hence a modest start can be made.

National focal points already linked to sectoral networks exist in some developing countries, but they must receive assistance to develop the capability to acquire the appropriate hardware, software and linkages. Education and training, in these and other important aspects of operating adequate scientific and technological information systems, should be an important sphere for international co-operation.

The Advisory Committee recognizes the existence of many scientific and technological information networks; some are within the United Nations system, many others outside of the United Nations system are of a regional nature (for example, Euronet) or are non-governmental. The global network should not be envisaged as a duplication or a replacement of already functioning networks or systems, but should be built upon them, in a phased manner, to strengthen, and to enhance their effectiveness, appropriateness and coverage. In addition, it would provide the mechanisms for co-ordinating these networks at all levels as the need and opportunity arise and ensure that expansions and additions are compatible.

The steps already taken by the United Nations system through the Advisory Committee for the Co-ordination of Information Systems (ACCIS) and the Task Force on Science and Technology for Development of the Administrative Committee on Co-ordination to achieve interagency scientific and technological information co-ordination should be strengthened and enhanced. Co-ordination at the regional level is already sought in certain regions and the global network should expand these tendencies as well as encourage national focal points to achieve national co-ordination. The World Information System for Science and Technology (UNISIST) should continue to play its role in facilitating the strengthening of national information infrastructures. International co-ordination must be recognized as the route towards the ultimate solution for many problems.

The specialized and/or sectoral information systems and networks which are already established at the national, regional and international levels, including those of the United Nations system, are essential contributors to the meeting of the actual needs of developing countries. It is clear that, in recognition of the multiplicity of requirements and needs, any monolithic restructuring at the national or international level is precluded. Yet, the concept of the global information network must be recognized to imply a need for increasing linkages as the opportunity and means arise. The criteria for this linking process leading to the phased establishment of the global information network should be to increase the usefulness and cost-benefit ratio of the concerned networks in assisting developing countries to achieve additional scientific and technological capabilities for development.

Since co-ordination and interlinkage imply the exercise of mutual influences towards common objectives at the policy setting, planning and implementation stages, it is important to establish formal mechanisms for such an interaction and to evolve these mechanisms gradually as the phased development progresses in scope and dimension.

As the global information system should ensure coupling of problem solvers with information services and data bases, it is essential for the global network to improve access not only to bibliographic, numeric and other factual data bases but also to sources of expertise, including those which produce, analyse and repackage information. The Advisory Committee, in analysing this wide spectrum of functions which should be performed within the framework of the global network, recommends that, as postulated in the Vienna Programme of Action, the full activation of a source referral function should be a first priority at the international level, to bring about a better knowledge and more effective use of available networks. Moreover, it should be considered the first step to be taken in a progressive and continuous programme for developing the global information network. INFOTERRA is a possible example of such a referral network.

Since the goal of the global information network is to serve the developmental goals of all countries by enhancing the application of scientific and technological information to their needs and priorities, the development of national capabilities for scientific and technological information utilization, generation and exchange is a paramount priority.

In previous reports, the Advisory Committee has suggested that "pioneer projects" might be attempted, using resources provided by interested Governments, institutions or donors. Because many developing countries have such poor access to even the most basic information, such as scientific journals, the Advisory Committee recommends the following idea for such a pioneer project to the Intergovernmental Committee and to the international community at large.

A series of projects should be initiated to furnish the universities, scientific and technological institutions and the national libraries of the less developed countries with important scientific journals through voluntary contributions. The aim will be that these institutions should acquire a basic stock of journals and literature on science and technology.

In addition, the Intergovernmental Committee, within the context of establishing the global network, might seek ways to initiate a permanent programme geared towards assisting and supporting the formulation of national scientific and technological information policies, with the creation and improvement of corresponding instruments and institutions as a high priority. Such a programme should cover the education and training requirements and assist in identifying common tools, management models and communication infrastructure appropriate for national needs.

The political will and commitment for co-operation and the assigning of resources will be a pivotal issue at the national, regional and international levels. The Advisory Committee suggests that there are few fields where such global commitment could have a wider or more lasting scope of impact.

PART ONE

Report of the *Ad-hoc* Panel of Specialists on Information Systems for Science and Technology for Development

Introduction

The Intergovernmental Committee on Science and Technology for Development decided in its resolution 6 (VI) of 8 June 1984 to adopt a selective approach that would enable it, at each of its sessions, to give depth to its deliberations by placing on the agenda one or two specific themes. It also invited the Advisory Committee on Science and Technology for Development to give a substantial part of its attention to an in-depth investigation of the themes selected by the Intergovernmental Committee, with a view to producing practical and action-oriented recommendations for consideration by the Committee. In the same resolution it decided to focus on information systems for science and technology for development as a substantive subject for in-depth discussion at its seventh session.

In resolution 2 (VI) of 8 June 1984, the Committee suggested that one of the Advisory Committee panels to be convened in 1985 should be on information systems for science and technology for development. After consultations within the Bureau of the Advisory Committee, it was decided to accept an invitation of the Government of Italy to act as host to the Panel in co-operation with the Istituto di Studi sulla Ricerca e Documentazione Scientifica of the Italian Consiglio Nazionale delle Ricerche.

In his opening remarks Umberto Colombo, Chairman of the Italian Commission for Nuclear and Alternative Energy Sources (ENEA) and chairman of the Panel, noted that in an era of rapid technological evolution that was leading the world to a society dominated by information and communication, scientific and technological information was a key resource. Hence, there was a need to establish national and regional networks for collecting, processing and disseminating scientific and technical information within the developing countries. He stressed that it was important for developing countries as a group to be able to cope with the problems related to scientific and technological information if they were to master their future.

The chairman reminded the members of the Panel that the theme of information systems for science and technology for development had been suggested by the Intergovernmental Committee at its sixth session and that the Committee planned to hold in-depth discussions on the theme at its seventh session. The conclusions of the Panel would be one of the main inputs to their work.

He also observed that the same subject had been a central concern at the United Nations Conference on Science and Technology for Development (Vienna, 20-31 August 1979) and that several recommendations on the matter formed part of the Vienna Programme of Action on Science and Technology for Development.[1] More specifically, attention had been focused on:

(a) The development of national policies, manpower and infrastructure in science and technology;

(b) The exchange of information covering national sources and related technologies, with particular emphasis on technological innovation and on the choice, transfer and adaptation of technologies;

(c) The establishment of a global network of scientific and technological information.

He cautioned that in dealing with those three points, one should not think only in terms of supply of information, with an emphasis on the quantity of information stored and distributed by a system or on the information support with which the system would be equipped. Rather, the final user of the scientific and technological information, his perceived and unexpressed wants and needs must be at the centre of concern.

He called the attention of the participants to the differences between the requirements of the users of scientific information, on the one hand, and those of the technological information itself on the other. He urged them to recognize that information was not an alternative to action, but, on the contrary, an essential element in the decision-making process and, hence, an instrument to allow action with a higher probability of success, to identify options and to select among them on the basis of previous experience.

Paolo Bisogno, Director of the Institute for Research Studies and Scientific Documentation, in welcoming the members of the Panel, emphasized that the growth rate of the technologically advanced nations and the dire situation that faced developing countries accentuated the need to provide them with the technologies best suited to fostering their self-propelled social and economic development. Those factors, he said, had made the provision of development-oriented scientific and technological information systems an issue of fundamental importance.

He stated that because of its geographical location and, most of all, its profound commitment to international co-operation activities, Italy was playing an ever-increasing role with respect to programmes aimed at devising development-oriented scientific and technological information systems for developing countries. To that end, the Institute that he headed had long been intensifying its activities by undertaking several co-operative initiatives with international organizations such as the United Nations Educational, Scientific and Cultural Organization UNESCO. Specifically, his institute had been collaborating with the Scientific Research and Higher Education Department of UNESCO since 1975 to draw up an information system project entitled Research and Human Needs Information System (RAHNIS). RAHNIS, he said, was an information referral service rather than a data base. Its purpose was to disseminate information on research, as well as on scientific centres and researchers working in developing countries, in an effort to assist in finding the solutions to some of their most serious problems.

In his opening remarks, the Executive Director of the Centre for Science and Technology for Development of the United Nations Secretariat welcomed the participants, acknowledging the importance of their expertise and their support. He thanked the Government of Italy for the additional support it was lending to international co-operation in sci-

ence and technology for development, by acting as host to the Panel. He informed the members of the Panel that the task before them was part of a new method of work established by the Intergovernmental Committee with a view to strengthening its role and increasing its effectiveness. That method, he stated, involved the selection in advance of one or two themes for in-depth consideration at each of the sessions of the Intergovernmental Committee. The theme of information systems for science and technology for development was the first such theme selected.

He pointed out that the Panel was unique in many ways. As the first panel based on this thematic approach, it qualified as a learning experience. Secondly, it was an exception in that there had been only one year to prepare instead of two years as mandated by the Intergovernmental Committee. Thirdly, in order to provide the best possible advice to the Intergovernmental Committee, an exceptionally large group had been assembled in a special effort to cover the broadest possible spectrum of technical expertise and institutional experience from both developing and developed countries.

The Executive Director stressed that the theme was both broad and complex and that it would undoubtedly require a great deal of effort to employ the limited time available efficiently and to build as much as possible on areas where agreement already existed. To assist the Panel in this regard, he called its attention to two conference room papers prepared by the Secretariat. The first was an issues paper entitled: "Information systems for science and technology for development: issues for consideration" (ACSTD/P.VII/CRP.1); the second, was entitled "Global network of scientific and technological information" (ACSTD/P.VIII/CRP.2).

Concepts and Issues

The Panel considered several basic issues relating to scientific and technological information systems. The essential elements and infrastructure of national information systems in developing countries were identified, as were the policies and institutional measures for establishing and developing effective systems at the national level. Recent trends and developments in information processing, including collection, storage and retrieval, and in communications systems at global and national levels were assessed, and their impact on information systems in developing countries at different stages of economic development were examined. The scope and implications of information policies, the development of specialized skills in information handling and processing and institutional arrangements were analysed in the context of the information needs of the principal user groups in developing countries. The linkages of the information systems of various United Nations bodies, other international organizations and non-governmental organizations with their respective counterpart institutions and organizations in developing countries were also reviewed, especially within the framework of a global information system on science and technology.

The Panel considered it useful first to define certain concepts relating to information systems and services. An "information system" essentially comprises a combination of various functions, including facilities for the collection and analysis of data, its storage and retrieval, and its dissemination to users; it is designed to interrelate information services functionally, drawing information from a coherent and unified stock of data. These functions require institutional and other arrangements for collecting knowledge from various sources, national and international, and for storing such knowledge for easy retrieval. They also require, especially in developing countries, institutional and other facilities for the dissemination of such knowledge to the users, including document delivery. Such facilities can range from complex computerized systems with satellite communications to various media and audio-visual arrangements and rural libraries and extension services. Such a system must cover an enormous range of subjects and include descriptions of research activities in particular fields, the specialized services available, institutional and technological capability in different areas, and the like. There are also information systems that list information sources, that is information-on-information or referral information systems, and bibliographic information systems, which cover a large proportion of all scientific and technical data.

The term "data" refers to a collection of raw information, facts and figures, the analysis of which may lead to conclusions, policy formulation or decision-making. A "data base" is a collection of organized, processed and stored data that may be in machine-readable form, in a card file, etc. "Information services" are those activities that provide access to recorded information resources and deliver the information, usually in the form of documents. Such services may also provide assistance in applying information in the solution of problems. There are also specialized information services that provide analytical and synthetic data and information processing tailored to special needs and the requirements of specific clients. An "information network" can be defined as a mechanism to interlink services and systems to give information to users at any given point. It may be a physical network that includes tools for the transmission of information or a human network that links human resources for information transfer.

The Panel noted that the Vienna Programme of Action stressed that scientific and technological information constituted a vital resource for the process of development. Several measures had been proposed at United Nations Conference on Science and Technology for Development including the formulation and adoption of national information policies by developing countries to strengthen and co-ordinate extension services, library facilities and the popularization of science and technology and its usage. The Conference also recommended the establishment of a global network of scientific and technological information to ensure close and intensive linkages between information users and information services, both in developing and developed countries.

The Panel stressed that scientific and technological information should support the objectives of national scientific and technological development and should promote the conversion and utilization of national resources, both physical and human, to meet development goals and facilitate the production of goods and services. Besides meeting sectoral needs and priorities, such information must also be intersectoral and multidisciplinary. The information flow should constitute an essential element in the development planning process and should be used in rationalizing the use of resources. The Panel agreed that while such information must be oriented to user needs, both the demand and the supply side of information should be given due attention in developing countries. The objectives of information systems and

services in developing countries should be not only to develop technological capability in various fields but also to ensure effective acquisition and transfer of technology from external sources. Information should lead to autonomous decision-making and to the generation and adaptation of technology. It should be an integral part of science and technology policies designed to enhance national capability for taking decisions on issues relating to science and technology. Information should also be used to facilitate the rational management of technology, especially at the national level in developing countries. Information systems should therefore include economic, social, legal and other information related to technological management and decision-making.

The Panel emphasized that developing countries comprised a diverse and heterogeneous group whose members differed in their level of socio-economic development and in their priorities. Consequently, information needs would also be diverse and the provision of technological information to meet such varied requirements was a complex task that would necessarily have to be geared to specific national requirements. Consequently, information systems and networks at both national and regional level might differ in content and in terms of sectoral and other priorities.

The Panel noted that development of information systems and capability should be viewed as a continuing process which was adjusted to meet changing needs and requirements. The availability of primary information sources (books, periodicals, etc.), as well as mechanisms to facilitate supply and disseminate information constituted key and basic elements of all information infrastructure. New technological developments had increased the complexity of infrastructure requirements, in terms of both equipment and the skilled manpower needed to handle and process scientific and technological information. It was essential for developing countries to develop endogenous capability in the operations and extensive use of information systems on science and technology. It was also necessary to develop information-packaging capability in developing countries and to extend dissemination mechanisms, especially extension activities, to many categories of users, including those in remote areas.

Information should be used also to improve the identification and selection of options, for national scientific and technological development, including research and adaptation in various fields and in choosing technology.

It was noted that policies and programmes for the collection, processing and dissemination of scientific information differed from those relating to technological information in view of the differences in content and in the requirements of user groups. Close relationship needed to be established between the demand side, representing both existing and potential user requirements, and the supply of technical information to such users.

The Panel considered that Governments in developing countries had a vital role to play in developing information capability and the use of technical information. The support of national leadership was necessary for the development of effective information systems. Such systems must, however, demonstrate their utility in terms of use and application.

The Panel also noted that it would be necessary to develop effective mechanisms for information education and training in developing countries on a national or regional basis. That process should also constitute an important element in technical assistance projects and programmes in various fields.

National Information Systems: Existing Situation and Needs

The Panel considered the development of national information systems and of greater capability in handling, processing and disseminating scientific and technological information, a prerequisite for rapid technological growth in developing countries. The Vienna Programme of Action and the operational plan[2] had placed special emphasis on the strengthening of such capability and on linking national information systems with regional and interregional information networks, as well as with those of United Nations organizations. The task of developing effective information systems in science and technology at the national level, however, was challenging and formidable. It necessitated a careful review of the existing situation and experience and of information needs and capabilities to use technological information in developing countries. In addition, the prerequisites and critical elements of such systems and the problems and constraints faced in their development would have to be defined.

While various institutional and other measures for the collection and dissemination of technical information had been initiated in most developing countries, the Panel was of the view that those measures had generally proved inadequate in meeting the requirements of the users in many important categories. In certain fields considerable scientific and technical information had already been disseminated through institutional mechanisms at the national level. However, the scientific and technological base was very weak in most developing countries and would require considerable strengthening before such information could be effectively used in technological decision-making. The Panel considered it necessary to develop more comprehensive information systems at the national level composed of various elements, data bases and subsystems and geared to the requirements of the main user groups in various fields. It was also essential to increase the capability of the principal user groups both to define the nature of their information requirements and to use effectively the technical information that was, or could be made, available.

Demand for Information

The Panel was of the view that much greater attention needed to be given to the demand side of scientific and technological information in developing countries. That would require increased activation of the principal user groups and the creation of an environment in which scientific and technological information would be required and utilized to a far greater extent than was currently the case. It was noted that the demand and market for information relating to science and for information dealing with technology differed considerably and that the groups that would normally use scientific information were distinct from those that would use information on technological processes and developments. The activation of demand and of the effective use of information might have to be tackled separately for those two user groups through various promotional measures, as well as through appropriate educational and training programmes.

Principal user groups

The Panel emphasized that national information systems on science and technology should initially be geared to the

requirements of the principal user groups in each country. Such users would include government departments and agencies, particularly science and technology policy-makers and planners; research institutions and universities; production enterprises; engineering and consulting firms; professional and trade associations; development banks; and individual entrepreneurs and researchers in various fields. The nature of the information requirements and the format in which information was delivered would vary considerably for these user groups and for various production and service sectors. Governments would, for example, require information on science and technology policies in other countries, as well as on the nature and extent of technology flows and payments for foreign technology. They might also require information on scientific results, technological innovations and trends in different sectors. The information needs of research institutions would largely relate to bibliographical and non-bibliographical material and sources for scientific research activities and institutions in other countries. Production enterprises and other user categories, on the other hand, would require information on technology sources, technological alternatives and the implications and experience of using different techniques and processes. Apart from meeting the extremely wide and diverse range of information needs of major user groups, national information systems should, first, provide adequate delivery systems and, secondly, organize effective dissemination of such information to end-users. The objective of national information policies should be to stimulate demand for technical information and to satisfy all user groups as far as possible, within rational cost considerations.

Present information facilities

With respect to national information systems on science and technology the Panel considered the existing situation in developing countries as diverse in terms of the infrastructure available and the extent of usage. Broadly, it was felt that most developing countries could be categorized in one of three country groups.

The first group comprised a few developing countries, in which the information infrastructure was fairly well-developed and included science and technology plans, policies and institutional arrangements, including computerized facilities for information flow in most critical sectors. Even in those countries, certain aspects needed strengthening—for example, access to the latest publications; multi-disciplinary information collection and processing; specialized training programmes; and facilities for the dissemination and application of information for user groups in a form in which it could be effectively utilized.

The second group was composed of several developing countries, in which information facilities had been set up in certain key sectors of the economy and an initial institutional and operational base for scientific and technological information had been established through universities, documentation centres and the like. However, the flow of information was often not continuous or comprehensive and only a few titles were available in complete collections. National lists of publications and periodicals had rarely been developed and document delivery systems were limited only to certain subject areas and sectors. In this group of countries, limited computer facilities were available for scientific and technological information. There was usually considerable deficiency in skilled personnel to operate institutional information facilities, as well as inadequate dissemination facilities and lack of capability in promoting a demand for technology by distinct user groups.

The third group covered a large number of developing countries in which information activities on science and technology barely existed or in which capability and usage were at a very low level. In those countries, there was very limited awareness, at the user level, of the importance of scientific and technological information; demand for such information had not developed; there was only fragmentary collection of periodicals and hardly any collection of titles; computer facilities were not utilized for such information; there were few skilled persons in information handling and processing; and, in general, there was inadequate development of information and infrastructure facilities.

The Panel was of the view that limited development of information systems at the national level could largely be attributed to the relative low priority given to scientific and technological information, as well as to the cost of developing such systems. That primarily reflected the paucity of resources but also an inadequate appreciation of the significance of scientific and technological information and its effective use in technological decision-making at various levels. While awareness in most Governments had increased there was a need for greater sensitization regarding the implications and critical aspects of the development of national information systems, with regard to both the promotion of user capability and the supply of a wide range of scientific and technological data suitably integrated and packaged to meet user demand in various fields.

The Panel stressed that the nature of the information required in various fields and sectors would differ considerably, as would the degree of detail necessary for various user groups and for countries at different stages of economic and industrial development. The flow of information and extent of updating necessary could also vary significantly and would have to be specifically determined in the context of each country and its stage of development. It would also be necessary to co-ordinate the information available with existing national services within the framework of a comprehensive information network. The Panel stressed that the development of national systems was essentially a continuing process with immediate and short-term goals and with long-term objectives. It would need to be suitably phased, the nature and extent of the phasing depending on specific country conditions, with progressive redesigning at different stages of development.

Constraints and limitations

Apart from the overall inadequacy of national information systems in most developing countries, several specific constraints were highlighted in the Panel discussions. Though several institutional facilities and services were available in a number of developing countries, the coverage, in terms of information supply and use was limited. There were also shortcomings in the generation of information at the national level. It was considered, first, that collection of technical information from national sources was inadequate and must be strengthened. Material on the industrial technology being utilized and developed, should also be collected from local enterprises and manufacturers as had been done in certain countries. Secondly, there was lack of access to primary in-

formation and literature. Thirdly, the growth of local data bases had been limited and that process needed to be accelerated. Fourthly, in most developing countries, there were serious constraints on the use of computers for processing information and of communications facilities for the transmittal and dissemination of information. While computerized facilities were not essential in every field, they were desirable in several areas, especially for linkages with international information systems and networks.

Information systems in developing countries would have to be planned in terms of the information needs and technological facilities anticipated in the coming years, and constraints with respect to hardware for information processing and communications needed to be overcome. Most developing countries also faced severe shortages of skilled personnel in information handling and processing. It would therefore be necessary to undertake extensive training programmes at the national level for specialized information personnel in different categories.

With respect to linkages to international systems, it was pointed out that there were serious problems of indexing and an important constraint in some countries arose from the fact that the query language was usually a foreign language. The utilization of foreign data bases was often limited because of language difficulties. If translation facilities were set up, not only would they be expensive but they might also delay the delivery of required information. The cost of accessing foreign data bases, including on-line facilities, was also fairly high and constituted a major constraint, especially in countries facing foreign exchange difficulties.

The Panel also emphasized that, in addition to meeting general and specific requirements, national information systems should be closely linked to development objectives. For certain categories of users, such as scientists in certain fields, adequate information linkages might already exist, but they would need to be suitably complemented by services tailored to end-user requirements. It would be useful to utilize informal patterns of information flow, in addition to formal institutional arrangements. Direct and personal contacts needed to be facilitated.

Co-ordination of information facilities

The Panel emphasized the need for close co-ordination of information systems, facilities and services at the national level in developing countries. Interlinking national services such as libraries, documentation centres and data bases was essential and constituted an important aspect of the development of national information capability. An important function of national nodal bodies or focal points would be to ensure such linkages and to prescribe policy guidelines in that regard. National focal points should also ensure a continuing awareness of the changing needs of principal user groups and should stimulate growth and change in information demand at different stages of development, with emphasis on the co-ordination of intersectoral information.

The institutional arrangements for co-ordination of scientific and technological information must be determined in the context of each country's requirements and its socio-economic and socio-political situation. The Panel was of the view that the general institutional pattern would be for national focal points to function primarily as co-ordinating bodies, with information flows normally taking place from a large number of sources of information for various sectors and functions. At the same time, while the Panel did not envisage the establishment of single, monolithic information institutions through which all information flows should take place, it was recognized that there might be varying degrees of integration in information services in different country situations. Given the heterogeneity of the developing countries, no one institutional structure could be prescribed as appropriate for all country situations. The Panel felt that there should be considerable flexibility, not only in different countries but also in the same country at different stages and levels of development. Neither demand for scientific and technological information nor conditions of supply were stable or followed any uniform pattern. Changes in the demand and supply of technological information would and were constantly taking place, and institutional arrangements to handle, process and disseminate such information should be adaptable to changing conditions.

The Panel noted that in several Western European countries, information networks on science and technology had evolved gradually. Most of such information still related to books and documents, and non-governmental institutions had played an important role in popularizing scientific material. Currently there was easy access to automatic bibliographic systems. Despite rapid technological developments, however, national catalogues had not been drawn up in all European countries, which was viewed as a shortcoming.

The role of Governments

In the case of developing countries, the Panel felt that the development of information systems and capability should not be left to the process of evolution but that deliberate and concerted efforts must be made to plan and develop such systems. With the very large scientific and technological gap between industrialized and developing countries, it was essential to have concerted and planned efforts to develop information systems and networks. National Governments must provide an important lead and take specific steps in that regard. The Panel emphasized that there should not necessarily be only one model of institutional arrangements and service facilities. A flexible approach should be adopted to meet the changing needs of the diverse societies found in developing countries. It would also be necessary to provide comprehensive extension facilities and services as complementary adjuncts to technology information systems. The foreign technology package, on which there continued to be considerable dependence, must gradually be reduced. Governments should ensure the development of information and technical service capability, supported by policy guidelines, to achieve that objective.

The development of national information systems and capability in developing countries must be carefully planned, with governmental initiative and support. It would be necessary, to assess user needs and promote user demand, especially in areas of special national interest and priority. A review of existing information services and facilities in each country including those for specific sectors, also needed to be undertaken. An assessment was also required of the extent and manner in which existing information services at national level were, in fact, being utilized.

Technical assistance

The Panel was of the view that technical assistance for the development of national information systems and appropri-

ate infrastructure and networking arrangements should be provided on request to developing countries by United Nations organizations and bodies, by other international bodies and through bilateral assistance programmes. Pilot projects should be undertaken to develop scientific and technological information systems in various categories of developing countries, on request from such countries. The projects could be used as models to be monitored and used in other countries, with appropriate modification and adaptation.

While institutional arrangements at the national level must necessarily be country-specific, they should be structured in such a manner that they could be linked and integrated with information systems at regional and interregional levels. It would also be necessary to determine the equipment and other facilities that would be required, including training programmes for local personnel and linkage arrangements at national and international levels.

The Impact of Trends in Information Collection, Processing and Dissemination

The Panel considered it necessary to take into account the revolutionary technological changes occurring in information processing and communications and their implications and impact on information systems and facilities in developing countries. Technological progress in the field of informatics had largely taken place in developed countries, where apart from major innovations in computers, micro-processors and communications facilities, there has been rapid growth of commercial information-processing facilities and services.

Transborder data flows were also increasing rapidly, mainly between institutions and corporations in industrialized economies. In most developing countries, however, traditional systems of information collection, storage and retrieval were being followed, with dissemination through various media and postal or oral communication. It was only in a few developing countries that satellite communications and computerized data-processing facilities were being extensively utilized.

The growth of the computer and semi-conductor industry was also very limited, though efforts were being made in a few developing countries to develop endogenous capability for the manufacture of computers and micro-processors, as well as to develop forward and backward linkages in cases of off-shore manufacture of electronic components. With limited use of computers and computerized data processing, information facilities in most developing countries continued to be centred around libraries, documentation centres, universities and research institutions using traditional systems and means of communications.

The use of electronics media

The rapid growth of electronics media and technological developments in information handling and processing posed important policy issues for information systems in developing countries. Both positive and negative aspects had to be taken into account. It was stressed that modern technological developments only provided sophisticated tools and mechanisms. Their effective utilization would largely depend on the selection and preparation of suitable inputs and appropriate use of the outputs from such facilities. Such technological facilities should only complement traditional systems of information collection and dissemination in those countries. While communication through satellites was desirable and even necessary for certain functions, the receiving end would also need to be suitably geared to the requirements of information processing. The Panel recognized that technological information sources and material in developed countries would increasingly be available only in computer-readable form. Facilities for receiving and processing such information, including package-switching, should consequently be made available gradually in developing countries.

Similarly, information search would become increasingly automated and would also necessitate corresponding facilities in developing countries. Such facilities could, to varying degree, be decentralized. Specialized training programmes would undoubtedly be necessary, but the number of computer experts would not be very large. More important would be the training of information specialists to handle, store and retrieve technical information. The development of computer facilities should lead to the growth of local data bases and to more efficient organization of relevant information through directories and the like. An important aspect would be the development of standardization so that information could be shared to the maximum extent. Administrative procedures would also require suitable modification and the example of computer tapes being held up in customs offices was cited. The Panel emphasized, however, that non-computerized information and facilities would continue to be required in developing countries. That would be essential for the supply and dissemination of various types of technological information. It would be all the more necessary to use non-computerized facilities to promote the demand for technological information, since the packaging of information that would be attractive to user groups in developing countries might vary from computer formats. There was, in fact, a need to train personnel in the packaging and promotion of scientific and technological information.

While there were obvious advantages in using modern technological facilities for data processing and communications, the Panel emphasized that costs would be high, and the cost-effectiveness of such facilities, over a period of time, should therefore be ensured. There were several technological alternatives available and the hardware and software needed to be carefully selected. In the case of equipment, for example, the maintenance aspect would be of importance and would need to be weighed against possible obsolescence. The sharing of computer facilities could bring about a significant reduction in costs.

Nevertheless, the cost factor was critical, both at the initial and maintenance stages and for obtaining data from commercial data bases. Each country must therefore determine the stage at which computerized facilities for information processing should be developed, together with the nature of such facilities.

It was noted that, in certain developing countries, specific policies were being adopted for increased use of computer in several sectors. There was a growing emphasis on standardization and maintenance of equipment. It was recognized that the development of software was a critical element in most developing countries, but that was also closely linked to the selection and use of equipment. The increased use of electronic facilities in developing countries would require greater sensitization and awareness on the part of policy-makers in those countries, especially in the context of information sys-

tems. That would also involve suitable adaptations of existing uses. For example, satellite facilities used by industrialized countries were often for single functions such as television transmission or meteorological reporting. In developing countries, such facilities could and had been utilized for multiple functions quite effectively.

The Panel was of the view that computers and telecommunications were increasingly emerging as the lingua franca of scientific and technological information. Developing countries should avail themselves of those facilities in their information systems and networks to supplement traditional systems of information collection and dissemination. While comprehensive abstracts and registers could and had been prepared in certain countries without the use of such facilities, computer and modern telecommunications provided basic and efficient tools that should be utilized in information systems in conjunction with existing systems and facilities, in countries that could allocate the necessary resources for that purpose.

With respect to cost-effectiveness, the Panel felt that the returns were often not obvious and that, in the present electronics age, it was necessary to introduce and use new technologies at least on a limited scale in order to keep abreast with the times. It was also noted that hardware costs, though still high, had decreased considerably in recent years. With present technological trends, greater efficiency could undoubtedly be achieved in information handling and processing, including search and document delivery. Appropriate measures therefore needed to be taken by developing countries in this regard. However, the Panel stressed that no static or uniform model of policies and programmes could be proposed and major variations in the light of varying country situations would not only be inevitable but quite appropriate. What was necessary was a fairly flexible mix of modern and traditional techniques for processing and disseminating scientific and technological information which would be suitable for specific country situations in terms of resources, requirements and levels of development.

The Nature of Information Requirements.

With the large number of user groups ranging from Governments, research bodies and production enterprises to professional associations and individual end-users in rural and urban areas, the Panel concluded that the requirements of scientific and technological information in developing countries were extremely complex and varied. In the case of Governments, apart from information on science and technology policies, technology flows and the experiences of other countries, especially developing countries, information would be required on science and technology activities and programmes being funded multilaterally through the United Nations Development Programme (UNDP) and other international bodies. The information requirements of other user groups were also specific to their needs, ranging from bibliographical references and hard copies to detailed information on particular technologies and experience of their use.

It was felt that special attention should be given to the information requirements of end-users, especially in rural and non-metropolitan areas in developing countries. The information needs of such end-users might extend beyond technological information and cover various other development aspects. The Panel also felt that more information should be collected and disseminated on "hands-on" technology, which would be of special interest to such end-users. The successes and failures of particular technologies also needed to be highlighted. The specific requirements of end-users in rural and non-metropolitan areas and of small-scale and cottage industries should be given special attention by national information systems and national focal points.

The Panel emphasized the role of non-governmental organizations in collecting, popularizing and disseminating technological information. Several specific cases were cited of technologies available in developing countries which could be usefully utilized in other countries and which had been located and disseminated through such bodies. It was pointed out that, in several industrialized countries also, non-governmental organizations had served as useful mechanisms for spreading scientific and technological information in a form understandable to the end-user.

It was the view of the Panel that all available channels should be utilized for the dissemination of technological information, especially to end-users in rural areas. Apart from rural technology centres, demonstration units and other institutions involved in field activities, dissemination should be carried out through fairs, study tours, scholarships and other forms of contact for end-users. Informal and personal contact played a major role in technological decisions by end-users.

The Panel stressed the need for adequate and rapid access to bibliographical information, as well as to referral systems, for developing countries. It was pointed out that considerable bibliographical material was available from United Nations information systems and other sources. Such information was also extensively available from commercial data sources, but access to such sources might be expensive. It was considered necessary to strengthen bibliographical information sources at the national level in developing countries, so that such information could be fully documented.

With respect to referral information, which was considered vital for developing countries, it was noted that information needs were quite diverse and the preparation of directories would need to be selective and developed for different sectors and functions. It was pointed out that in several developing countries the receiving end was weak, and unless strengthened considerably, it might not be possible to use referral systems efficiently. It was therefore necessary to provide facilities for delivery of hard copies. It was also necessary to provide technical assistance to countries to build the institutional infrastructure to utilize referral systems efficiently and adequately. Referral systems also might not be adequate for small industries and other such users. It would be necessary to analyse and annotate technical references, especially in the industrial sector in developing countries. It would also be necessary to repackage technical data and information to meet end-user requirements. Such repackaging would require specialized services at the national level and extension services at the field level.

The Panel emphasized that information on industrial technologies constituted an essential need for most developing countries. There was only limited information available from existing data bases in that regard. It was noted that valuable information on technological alternatives was being collected and disseminated by the United Nations Industrial Development Organization (UNIDO) and certain other organizations of the United Nations system such as the Technical Memo-

randa Service of the International Labour Organization (ILO) as well as through governmental institutions in certain developing countries. Technological information was also available in patent documents. However, it was considered essential that the collection and dissemination of information on alternative technologies, the sources of such technologies, experience with their use and other related information, should be expanded considerably at national, regional and international levels. Such information would necessarily be sectoral and should contain material that would permit technological decisions to be taken.

The Panel was also of the view that scientific and technological information systems needed to be complemented by socio-economic, legal and transactional information regarding the use of technologies in various fields. Sources for such information were also very limited and needed to be developed and expanded at various levels.

The Panel concluded that, with the multiplicity of needs, it was difficult to provide absolute priorities regarding the nature of the information required. Institutions already existed in most countries and were functioning at different levels of technical capability. The Panel agreed that it was preferable to build on existing systems and institutional arrangements and to cover the gaps in the context of each country's priorities. In view of the costs involved, it would be necessary to phase the development of information institutions and services at various levels in different stages and over a period of time. Information on technology should be given special emphasis in developing countries, but the information requirements were extensive and would have to be met gradually in stages. Information by itself would also not be enough. It would be essential to provide advice and technical assistance regarding the selection of hardware and software and to develop information infrastructure at the national and local levels. Extension services were particularly important in translating information into programmes and projects and constituted an essential and complementary aspect of information systems.

The Panel took note of several existing information networks and systems that were described. They included EURONET, which was serving the European countries and which could be extended to ACP and other developing countries, and TECHNONET, which was designed for middle-sized and small-scale industries in Asian countries. NTIS (USA) was providing scientific and technological information to users in several countries. The patent information system organized under the auspices of the World Intellectual Property Organization (WIPO); INFOTERRA, which was operated by the United Nations Environment Programme (UNEP); INTIB of UNIDO; AGRIS, CARIS and other information services of the Food and Agricultural Organization (FAO); INIS of the International Atomic Energy Agency (IAEA) and the systems of other United Nations bodies were also described and discussed. Most of these organizations reported on their activities in strengthening national and regional infrastructure in their fields of competence. Mention was also made of the activities of such bodies as the Regional Centre for Technology Transfer (RCTT) in Bangalore. The scope and nature of commercial data bases, especially in the United States, were also described in the course of the Panel discussions. Mention was also made of the UNDP Technology Information Pilot System (TIPS), which was to be developed as a pilot programme to link several developing countries. That project, which had an intersectoral approach, would provide networking facilities and communication links and should lead to greater technical co-operation among developing countries and also catalyze the establishment of the global information network.

The activities of private data bases were briefly discussed. Institutions like the Institute for Scientific Information (ISI) were exploring the possibility of providing services to developing countries at lower rates. IDRC of Canada was supporting developing countries to build up their capacities in information services. The experience of IDRC in having online access to several United Nations data bases, for the time being restricted to users in Canada, was also described.

International Linkages and the Establishment of a Global Information Network

The Panel agreed that the development of a global information network should not mean the replacement or duplication of any existing or planned science and technology information systems, services or networks, whether sectoral, regional or international, but should be viewed essentially as a means of strengthening them—for example, through the establishment of the intersectoral linkages needed to increase the usefulness and effectiveness of such systems for developing countries.

To establish such linkages, the need to expand coverage and improve the operational capabilities of such systems, services and networks at the international level, as well as the possibilities of doing so, should be assessed. The efforts needed to develop linkages should be made building upon existing elements to the extent possible. Both expansions and new initiatives should be guided by users' demand, on the one hand, and by the necessary political, institutional and financial commitments, on the other.

The development of linkages, although evolutionary, should proceed with all deliberate speed. It would demand concerted efforts by the Governments of both developed and developing countries, the United Nations system, other intergovernmental organizations and non-governmental organizations, as well as by the international scientific and technological community. It would require considerable mobilization of financial and technical resources.

The complexity and magnitude of the task as a whole necessitates the preparation of a detailed, comprehensive, long-term programme of work. However, at this stage, some guiding principle must be formulated, so that the various steps on which the process depends could be scheduled within foreseeable constraints and in response to the relative urgency of each step.

Since the envisaged global information network should serve all countries, especially developing countries, strengthening their information systems, thereby supporting the creation of additional scientific and technological capabilities, should be the main network development goal, in accordance with the needs and priorities of each country.

To enhance the use of information, an international programme of a permanent nature should be geared towards assisting and supporting the formulation of national scientific and technological information policies, the creation and improvement of corresponding instruments and institutional structures and education and training activities. The pro-

gramme should address the development of common tools, such as software and procedures, as well as the management and communication infrastructure of national systems and networking.

While many of those elements would clearly be country-specific, reflecting cultural, political and institutional structures and specific development stages and goals, an international programme should play a positive role in providing not only the mechanism for the co-operative, cost-effective development of tools and methodologies, but also the conditions and opportunities for the active exchange of the experience in areas of common concern. The Panel agreed that UNISIST, whose vast experience and significant contributions in this respect were acknowledged, should continue to play a role and recommended that it should be strengthened both in financial and technical terms.

The Panel agreed that the objective of the global information network was to ensure an effective and intensive coupling of problem-solvers in developing countries with information services and data bases. As the information to be provided through the global network should support problem-solving processes, it was essential for the network to provide access not only to bibliographic, numeric and other factual data bases but also to sources of expertise, including those that produced analysed and repackaged information.

In analysing the wide spectrum of functions that should be performed within the framework of the envisaged global information network, the Panel agreed that, as postulated in the Vienna Programme of Action on Science and Technology for Development, the full activation of the source referral function (information-on-information) should contribute not only to better knowledge of existing systems and networks at the national and international levels, including United Nations and commercial systems, but also to promoting more effective use of and increased interaction among them. INFOTERRA was mentioned as an example in this connection. It should be decided, after detailed study, whether it would be appropriate to extend the system to attain the coverage intended through a global source referral system on science and technology for development, and if so, how that process should be carried out.

While recognizing the important service that could be provided and the catalytic role that the source referral system could play, the Panel also emphasized the importance of the specialized and/or sectoral information systems and networks that had been established or were envisaged at national, regional and global levels and that covered subjects and information functions of great interest and relevance to developing countries. The plurality and diversity of information functions implied in the concept of a global information network on science and technology for development that was intended to facilitate closer contact between users and suppliers of information, with due consideration to the specific needs and particular context of each developing country as illustrated by existing systems, services and networks, would certainly preclude any attempt to structure the global network in a monolithic fashion. Therefore, while specialized or sectoral systems, whether old or new, regional or global, should adopt the structures and operating characteristics best suited to their proposed objectives, the establishment of appropriate linkages among them should be undertaken as opportunities arose.

The Panel expressed the view that the basic criterion to guide the interlinking processes, or the gradual establishment of the global information network, should be to increase the usefulness and cost/benefit ratio of the different systems and networks. Therefore, such interlinkage might take place at different levels (national, regional, cross-regional, global) and at different paces, depending on needs and feasibility.

Software developments, coupled with the decreasing costs of data processing and transmission, were leading to virtual compatibility among different systems and networks from the user's point of view. That would allow the user to employ a single communication channel and terminal processing unit for multiple access, as in the case of commercial data bases. While it was recognized that not all the systems of interest were computerized or needed to be accessed in such a manner, a co-operative effort among the various organizations and agencies concerned might provide effective interaction between the respective systems, at different levels of their focal points.

To facilitate and enhance such a process, increased co-ordination should be sought at different levels, not only among government agencies and institutions (local or national focal points of different systems and networks), but also among intergovernmental and non-governmental organizations (corresponding to regional or global focal points). Since co-ordination implied the exercise of mutual influence by those seeking common objectives, the Panel deemed it essential to provide the means and opportunities to exercise such influence, especially in the policy setting and planning stage, but also in the various implementation phases of the co-operative effort. Therefore, the establishment and maintenance of formal mechanisms for such interaction was important. Such mechanisms could be expected to evolve only gradually, building upon the positive results attained in successive attempts, to increase the scope and dimension of the co-operative efforts.

In the case of the United Nations system the Panel recommended that, to establish the global information network, the existing co-ordinating and co-operation mechanisms and procedures, such as ACCIS and the working groups and joint activities of the Administrative Committee on Co-ordination Task Force on Science and Technology, should be strengthened. The Panel also recognized that research related to the global information network could be performed in a systematic way by United Nations University (UNU) and similar institutions.

The Panel also considered the availability of primary documents (books, periodicals, etc.) and their delivery as critical problems that would have to be resolved to avoid jeopardizing the usefulness of many existing international information systems and networks. The problem affected developing countries in particular. Owing to the high costs and delays which could result if the problems were not resolved, the Panel recommended that co-operative efforts and arrangements in this regard should be studied and implemented, at both national and international levels, as an important and urgent infrastructure measure for the establishment of the global information network.

It was pointed out that the development of the national systems and networks depended essentially on the resolve and commitment of the Governments concerned to promote the indispensable political, institutional and financial conditions. Therefore, the development of the necessary international linkages depends on their collective political will, expressed not only through formal resolutions but also

through concrete actions to create favourable circumstances. Of particular importance was the provision of all the resources necessary to carry out effectively the tasks deemed necessary to reach their common objective, as expressed in the Vienna Programme of Action.

The Panel agreed that the mobilization of such resources would be accomplished in many different ways. Proper assignment of priorities within the regular budgets of the various international organizations and the various international financing agencies or mechanisms, such as UNDP and the United Nations Financing System for Science and Technology for Development (UNFSSTD), while indispensable, may not be sufficient to raise the needed resources. Special contributions are called for, both through multilateral and bilateral arrangements, such as the contribution of IDRC, whose past, present and envisaged support accounted for important developments. Without such concrete expression of support and participation, even if made in relatively modest terms, meaningful progress would be difficult.

Notes

1 See **Report of the United Nations Conference on Science and Technology for Development, Vienna, 20-31 August 1979** (United Nations publication, Sales No. E.79.I.21 and corrigenda), chap. VI, sect. A.

2 See A/CN.11/III/CRP. 3. Approved by the Intergovernmental Committee on Science and Technology for Development in resolution 2 (III) of 5 June 1981.

PART TWO

Concepts and Issues

Information Systems For Science and Technology for Development: Issues for Consideration

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Introduction

Legislative mandate

The Vienna Programme of Action placed great emphasis on the development of endogenous capability in developing countries in science and technology. It was also stressed that scientific and technological information constitutes a vital resource which must be harnessed and integrated with the process of development. Several measures on scientific and technical information were proposed by the conference, including the need in developing countries for the formulation and adoption of national information policies as an integral part of the overall national development plans; the strengthening and co-ordination of agricultural and industrial extension services; the development of library services; and the use of mass media to popularize science and technology. The conference also recommended the establishment of a global network of scientific and technological information, to ensure close and intensive linkages between information users and information services, in both developing and developed countries.

In recognition of the crucial role of scientific and technological information in the development process, the Intergovernmental Committee, at its sixth session, decided, in its Resolution 6 (VI) of 8 June 1984, to focus on information systems for science and technology for development as a substantive subject for in-depth discussion at its seventh session, from 28 May to 7 June 1985. This paper identifies some of the principal issues for discussion by the *Ad Hoc* Panel of Experts on Information Systems for Science and Technology for Development in Rome from 21 to 25 January 1985, which will serve as an essential input for the preparation of the report to the Intergovernmental Committee. The recommendations of the *Ad Hoc* Panel will be considered by the Advisory Committee on Science and Technology for Development at its fifth session, in February 1985.

Scope of report to Intergovernmental Committee

Since the report to the Intergovernmental Committee will need to analyze the role of scientific and technological information and information systems in the development process, especially in developing countries, it will be necessary for the *Ad Hoc* Panel of Experts to consider several basic issues in this regard. The essential elements and infrastructure of national information systems in developing countries will need to be identified, together with policies, programmes, and institutional measures for establishing and developing effective systems at the national level. Recent trends and developments in information processing, including collection, storage and retrieval and communications systems at global and national levels, should be assessed, together with features and trends in information systems in developing countries at different stages of economic development. The scope and implications of information policies, development of specialized skills in information handling and processing, and institutional arrangements will need to be analyzed in the context of the information needs of the principal user groups in developing countries. The linkages of information systems of various United Nations bodies and international organizations with their respective counterpart institutions and organizations in developing countries will also need to be reviewed, especially within the framework of a global information network on science and technology.

Definitions

It will be useful initially to define some of the concepts relating to information systems and services. An *information system* essentially comprises a combination of various functions, including facilities for collection and analysis of data, its storage and retrieval, and its dissemination to users. These functions require institutional and other arrangements for collecting knowledge from various sources, national and international, and storing such knowledge for easy retrieval. They also require, especially in developing countries, institutional and other facilities for the dissemination of such knowledge to the principal user groups. Such facilities can range from complex computerized systems with satellite communications to various media and audio-visual arrangements and to rural libraries and extension services in these countries. The coverage of such a system necessarily extends to an enormous range of subjects, including research activities in particular fields, availability of specialized services, description of institutional and technological capability in different areas, and the like. There are also information systems that list information sources, i.e., information-on-information or referral information systems, together with bibliographic information systems, which cover a large proportion of all scientific and technological data. *Data* is a collection of raw information, facts and figures, the analysis of which may lead to conclusions, policy formulation or decision-making. *Data base* is organized, processed and stored data. It may be in machine-readable form, on file cards, or in

other forms. The term *information services* refers to those activities that provide access to recorded information resources and provide its delivery, usually in the form of documents and those that provide assistance in applying information in the solution of problems. There are also *specialized information services* which provide analytical and synthetic data and information processing tailored to the special needs and requirements of specific clients. An *information network* can be defined as a mechanism to enable individuals, groups of people, and institutions to exchange either bilaterally or multilaterally messages, information, and various types of data. Networks also relate to communications linkages such as satellites, telephones, teletext, videotext, and, more recently, teleconferencing and computer conferencing.

Development of National Information Systems on Science and Technology

While various institutional and other measures for collection and dissemination of technical information have been initiated in most developing countries, these have generally proved to be inadequate to meet the requirements of the principal user categories. Certain kinds of technical information, such as that dealing with agricultural methods and practices or public health measures, have been effectively disseminated and applied; but by and large there is great need for strengthening the scientific and technological information base and for more effective use of such information in technological decision-making in developing countries. This requires the development of an integrated science and technology information system at the national level, comprised of well-defined elements, data bases, and sub-systems geared to meet national requirements in various fields. The nature of the technological information required in various fields and sectors may differ, as may the degree of detail necessary for various user groups. The flow of information and the degree of updating that may be necessary may also differ and may need to be specifically determined in the context of each country at various stages of development. The information available in existing national services will also need to be co-ordinated within the framework of an integrated information network.

The development of national information systems and of capability in the handling, dissemination, and use of scientific and technological information needs to be carefully planned. It will be necessary to assess user needs in particular areas of information, both general and sectoral, which are of special national interest and priority. A review of existing information services for specific sectors in each economy also needs to be undertaken, gauging the extent to which such services are in a position to meet the identified information needs of the principal user groups. An assessment is also needed of the extent and manner in which existing information sources at national level are in fact utilized, particularly by government authorities, research institutions and production enterprises.

It may be necessary to provide assistance to developing countries, on request, for the development of national scientific and technological information systems and appropriate networking arrangements and for implementing nodal functions and responsibilities. While institutional arrangements at the national level must necessarily be country-specific, these should be structured in such manner that they can be linked and integrated with information systems at the regional and international levels, including systems maintained by United Nations bodies. It is also necessary to determine the equipment and other facilities, including training programmes for local personnel, that may be necessary for efficient operation and maintenance of national systems. Suitable institutional and other arrangements will need to be made for implementing such a programme.

Issues

1. What has been the experience of national information systems in developing countries with respect to scientific and technological information?

2. What are the principal gaps and shortcomings faced by national institutions and information systems in developing countries with respect to (a) access to sources of scientific and technological information; (b) storage and retrieval facilities; and (c) dissemination arrangements?

3. What are the policy and institutional measures necessary for the effective development of national information systems on science and technology?

4. What other critical features and elements should be incorporated in such national systems and in networking arrangements?

Trends in Information Processing and Communications

Recent technological developments in computer usage and in complex communications systems have resulted in close linkages between data processing and telecommunications and have brought about revolutionary technological changes in data and information processing. The processing, storage, and retrieval of a wide variety of scientific and technological information can now be undertaken on an international scale, and there has been rapid growth of transborder data flows, especially between institutions and corporations in industrialized countries. Technological progress in the field of "informatics" (information processing and communications) has largely taken place in developed countries where, apart from innovative developments in microprocessors, computers, and communications facilities, there has been rapid growth of specialized data-processing facilities and services, both through governmental institutions and channels and through commercial information sources and systems, which have multiplied in number and cover a wide range of general and specialized information and data.

In developing countries, information systems and communications facilities cover a very wide range, extending from certain countries which have satellite communications and where computerized data-processing facilities are expanding fairly rapidly to those which continue to operate through traditional systems of information collection and dissemination through various media and through postal or oral communications. In some developing countries, specific measures have been adopted for indigenous growth of the computer and semi-conductor industries and of data processing. In several countries, especially in Southeast Asia and parts of South America and the Caribbean, offshore assembly and manufacturing facilities have been established by transnational corporations from industrialized countries to

assemble parts and components for semi-conductors, consumer electronic products, and other electronics products. Except in a very few of these countries, such assembly operations have not resulted in significant backward and forward linkages, though these have provided employment opportunities and have had a positive impact on the balance of payments of the countries concerned. In most developing countries, however, there has been very little growth in the production and use of computers. Except in a very few of these countries, there has also been very limited growth of computerized data-processing, and software facilities for information processing and dissemination remain relatively undeveloped. Facilities for collecting and storing technical information and for its dissemination in most developing countries are centered around libraries and documentation centres, research institutions, universities, extension services; and facilities in sectors such as agriculture, agro-processing, small-scale and cottage industries, and the like, using traditional systems and means of communications. Since effective dissemination constitutes a critical aspect of any information system and since, in developing countries, such dissemination involves transmission of technical information to rural and underdeveloped regions within these countries, this may involve the use of media such as TV and radio and the use of extension agencies and other institutions, which are served by such communication facilities as may be available, including telex, telephone, and postal mail. At the same time, insofar as the obtaining of scientific and technological information is concerned, it will be necessary for national institutions in developing countries to have access to scientific and technological information that is available from national, regional, and international information systems and sources, using modern, computerized facilities for its collection, storage, retrieval, and communications. The handling and processing of this information will also require the development of technological infrastructure in the form of hardware and software, specialized skills in data-processing and management.

Issues

1. In view of the technological revolution in data-processing and global communication systems, what are the broad policy measures with respect to computer use and telecommunications facilities that need to be considered by developing countries at various stages of development, for the purpose of structuring their scientific and technological information systems? What are the alternative institutional arrangements in this regard?

2. What specific measures should be considered for the development of operational and programming skills with regard to computers and telecommunications, and the development of the data-processing facilities needed in these countries?

3. What institutional and other measures should be considered for the development of national capability in data-processing and software programming, and how should these be integrated with existing institutions dealing with scientific and technological information in these countries?

4. What would be the appropriate "mix" for developing countries in various stages of development in terms of the latest technological developments in "informatics" and the use of traditional systems and institutions for collection and distribution of technical information?

Nature of Scientific and Technological Information Required

The requirements of developing countries with respect to scientific and technological data and information will vary considerably for different user groups. The principal user groups will be government departments and agencies, universities and research bodies, public and private enterprises, and individual researchers and entrepreneurs in various fields, besides user groups in rural areas in these countries. The nature of scientific and technological information required will differ considerably for these user groups. The information required by governments, for example, will not only relate to science and technology policies and their impact but also to scientific and technological innovations and trends in different sectors. Information is also necessary regarding technology flows and payments for foreign technology and services, in order to assess and monitor the impact of technological change in various sectors within each national economy. The information needs of national institutions dealing with science and technology will extend to relevant bibliographical sources and information on scientific research activities in various fields. Information requirements of public and private enterprises will need to cover data for technological decision making, including information on technological alternatives and the implications of their use. The latter category of information may also be necessary for policy-making by governmental bodies and institutions. For user groups in rural regions, the nature of technical information will tend to be different and greater emphasis may be required on effective dissemination through audio-visual means.

Since the nature of scientific and technological information will differ considerably, it would be necessary to develop linkages with international information sources covering not only sectoral information but also bibliographical data on research activities, information on alternative technologies and experience with such alternatives, and full-text scientific and technical material in various sectors of special interest and priority to particular countries.

Issues

1. Should the coverage of scientific and technological information required by developing countries be as indicated above, or should it be focused on particular types of information only, e.g., bibliographic or referral information?

2. Apart from the major user groups indicated above, are there any other user groups in developing countries which need to be specifically covered?

3. How should the specific needs of rural areas be handled?

Linkages with International Systems

Several sources of scientific and technological information exist in most developing countries. These include universities, research institutions, scientific information and documentation centres, and specialized information units dealing with particular sectors. Many of these institutions are linked with external bodies and institutions which provide varying levels of scientific and technological material. Despite these efforts and developments, the availability of scientific and

technological information in developing countries is generally considered to be very inadequate, and closer linkages with international information systems appear to be very necessary.

International information systems comprise various systems and data bases which can be operated on a global basis, and include the information systems of United Nations bodies and organizations and international information systems. In the United Nations system, several bodies and organizations have information systems relating to their field of activities. As for other data bases which can be internationally used, these include bibliographic, referral, numeric, mixed bibliographic-numeric, and full-text data bases covering most scientific and technical fields. These computerized data bases can generally be utilized through subscriptions, which vary considerably with the nature of the information involved.

Issues

1. In what manner can information systems of various United Nations bodies and agencies be utilized more effectively in developing countries? Would the establishment of a central national node be more conducive to co-ordinate such information at the national level?

2. As regards commercial data bases, can these be directly utilized in view of the lack of information and the foreign exchange and communications constraints in most developing countries? What selective measures can be considered in this regard?

Global International Network on Science and Technology

Since closer linkages with international information systems are needed by developing countries in order to avail themselves of the scientific and technological information in various fields, it is necessary to visualize such linkages within the framework of a global information network on science and technology.

Issues

1. Would the proposed global information network provide adequate linkages between technological information requirements at the national level and information systems and data bases at the international level?

2. Should the role of the global node be confined to referral functions, and would the provision of such referral functions alone meet the detailed and specific information requirements of user categories in developing countries?

Information and Technological Development: Definition of Terminologies

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Definitions

With the purpose of establishing a common language for expressing the meaning of terms to be employed in preparing the report on information and technological development to the Intergovernmental Committee, the following basic definitions are proposed:

Data

Basic elements for quantitative and/or qualitative knowledge on a theme, fact, situation, procedure, activity, business, document, and/or person.

Information

A set of data corresponding to a specific aspect of knowledge, combined in an organized way.

Information system

A mechanism that allows for the collection, classification, handling and retrieval of information contained in a file through manual, mechanized or electronic procedures, as well as the generation of new information through the processing of existing information.

Information systems can be classified either according to the way the information is received (by "direct access" or by "referral"), or according to the subject covered (general knowledge, sectoral knowledge, or specialized knowledge).

A *direct access* information system allows direct access to the source of information required. A *referral* information system is one that allows for identification of the sources that contain the required information. There are two types of referral systems: the *bibliographic* which contains references to books, periodicals and documents; and the non-bibliographic which contains references to persons, institutions, information sources and documents that are not widely disseminated such as theses, reports, and catalogs.

Classified according to the subject area covered, information systems include the following: The *general knowledge* information system which allows access to news, comments and non-specialized information. The *sectoral* information system which allows access to information for an economic or technical sector, and which is organized to correspond with specific problems faced by users. Being oriented toward the solution of problems of varying degrees of complexity and urgency, the information handled within such system also varies in its origin, the format in which it is required, and its depth or scope. The *specialized* information system which allows access to information on a specific activity or aspect of the economy, society, culture or policy. Its orientation is toward the collection, processing and diffusion of a certain type of information and may therefore be homogeneous as regards its sources, their origin, frequency, presentation format, priority, and users.

Information network

Information network is a set of information systems and users connected through communications linkages. Information networks may be classified according to their *topology*, the *subject area* covered, or their *geographical scope*. A network's topology, may be of either the "star" or the "spider's web" type. Its subject area may be of general, sectoral or specialized knowledge. In geographical scope, it can be local, national, regional or global.

A *star-type* information network is one in which users and/or providers of information communicate with a central system and have no contact among themselves whereas an information network of the *spider's web* type is one in which there is the possibility of direct information exchange between any two of the information systems and/or users which integrate it.

Classified according to subject area a *general knowledge* information network is comprised of one or more general information systems and their users; a *sectoral* information network is comprised of one or more sectoral information systems and their users; and a *specialized* information network is comprised of one or more specialized information systems and their users.

As to *geographical scope*, a *local* network covers a zone or area within a country; a *national* network covers the whole country; a *regional* network covers a set of countries which comprise a subregion or region because of their geographical situation and/or their special integration agreements; and a *global* network is one which any country can join without geographical or agreement restrictions.

Informatics

The support which allows processing of data to convert it into useful information and the classification and storage of the data to facilitate its retrieval and use through computers.

Communication network

A set of linkages which allows for the exchange of information among components of an information network.

Communication networks may use postal, telephone, telegraph or data transmission channels. Data transmission net-

works, may be public or private, depending on whether they use public telecommunication facilities or specially dedicated private circuits.

Importance of Information for Scientific and Technological Development

Scientific and technological policy has a fundamental purpose, namely, the increasing of a country's capabilities for autonomous technological decisions which may contribute to the attainment of its social and economic development goals. To accomplish this purpose, scientific and technological information is of particular importance in the decision-making process. Therefore, a strategy must be devised to provide for the generation, importation and assimilation not only of technologies, but also of scientific and technological information.

The concept of technology generation encompasses the various ways through which technology is acquired by endogenous, self-supported efforts, that is, through the performance of research and development activities, which in their broadest meaning, include copying and adaptation as well as creation.

In fact, technology (taken both as knowledge and as a commodity) is generally produced and exchanged commercially across national boundaries. The importation of knowledge is a means by which countries acquire a good part of the knowledge they use, despite the unfavourable business terms sometimes imposed on users for both hardware and software.

The way in which scientific and technological information is made use of is critically important. The information may be available through the decision-making process, playing a supporting role, but the timeliness with which it is brought into active use can influence strongly the attainment of the specific economic and social goals of the government institutions, productive enterprises and science and technology development entities involved.

Much has been said about the most propitious moment to initiate the use of technological information in the decision-making process. This question is directly linked to the type and depth of the information required at each step of the process. The perception of an investment opportunity may well depend on the availability of general information either through specialized periodicals in economic and technical fields or through catalogs and advertisements of equipment which may reach investors through specialized channels.

The decision-makers' search for and evaluation of feasible alternatives and their choice of which options to pursue often requires the availability of varied and detailed technological information. There is likely to be a need not only for technical specifications but also for economic and legal information related to the technological options, so that non-technical factors (including social costs and the influences a decision will likely exert on the economy) can also be taken into account, as well as technical standards and costs. Once a decision is made it must be implemented; and for this there will be a need for further detailed information on the alternatives, including whatever is needed for the assimilation, adaptation, maintenance and development of the technology involved.

Later on, it will be necessary to evaluate the results of the decision, including its technical and economic effects at both micro and macro levels. The information regarding results will have to be as comprehensive as possible so as to indicate clearly the corrections which may be needed.

So far, we have discussed the type and depth of the technological information required at each step in the decision-making process. We should now ask if the decision makers in government and private enterprise in developing countries are capable of receiving and processing all the information which is needed for their decisions and, on the other hand, whether the sources of information available in such countries are capable of collecting, classifying and disseminating the information which the decision makers need.

It is necessary to determine the mechanisms that will serve as bridges between industrial and technological knowledge and the uses of such knowledge, since in general, the technology that is exchanged internationally has been developed primarily for use in the industrialized countries, where the industrial enterprises and government institutions have the capability to develop, adapt and apply the technological knowledge.

Users of technological information in developing countries often lack the ability to make use of technological knowledge and in many cases, there is very little possibility of utilizing consulting services at a reasonable cost to help them make use of it. Therefore, a great majority tend to receive all their technological information from the providers of turn-key plants. Thus their use of technical assistance and machinery hinges on only a few sources of information when important decisions are made such as the selection of a process to be followed, the scale of production, and so on.

Although in a few cases available information services in the developed countries are utilized, these services act only as a linkage with the information sources of industrialized countries. Thus, the possibility of identifying, classifying and disseminating technological information that is generated internally in the developing countries is lost. Such endogenous information could perhaps provide more efficient solutions to the needs of developing countries if exchanged among them, since their social and economic characteristic are similar.

The information required for the adoption of decisions must take into account not only technical matters but also the economic and legal questions associated with its utilization and also the social effects of the decisions adopted. The sources to provide such information are varied and are not necessarily centralized in specialized institutions. Therefore, it will be often necessary to combine information flows which correspond to various different steps in the decision-making process. Authorities responsible for national technology policy need to organize methods that allow the user access to diverse sources of information through a national information system with linkages in other countries.

Issues Relating to a United Nations Global Referral Network: an Overview

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Summary

To be of a manageable length, this paper has ignored those "hardball" issues of system design that now must be undertaken to make the dream of a global information referral network a reality. Instead, an attempt has been made to focus discussion so as to identify and address detailed problems relating to the establishment of the network to be identified and addressed. As the issues are laid out here, they make clear what steps need to be taken for further development and where the systems design issues can begin to be explored in detail.

The issue of information divisions enables the drawing up of a map of the information territory within which the global system must function. Information divisions also imply priorities for system development. The fact that there are issues of information organization (for the realization of facts which are in the common domain, which have unrealized implications) as well as the provision of information (as related to the extension and employment of proprietary information) means that certain system design approaches are more likely to prove fruitful than others. What can be done as a starting point is to identify the main actors in the drama, and suggest approaches which might be fruitful. Trade-offs between system reliability, speed of function, and cost must also be faced at the outset, to maximize the probability of useful results for a given allocation of resources to the network. The existence of differing rates of innovation in specific disciplines has implications for the type of system which is to handle such information. Finally, the needs of system users dictate to a large extent the major characteristics of the information content of the global network.

The issue of governance involves the immediate acceptance of the interdependence of the members in the global system. How this governance issue is resolved and what technical guidelines must underpin it has obvious implications for the final shape of the global network. The need for fast results at lowest costs means some short-term expedients must be accepted which are not desirable in the long run so that managing this transition will be a significant challenge for governance of the system. Governance issues can only be addressed effectively in a framework of a control shared by the network members, with an implicit acknowledgement of the degree to which the benefits of participation mutually benefit the participants in the system. Internal governance within member nations is as much a legitimate concern of network design and operation as the governance of the network itself. Financial, legal, and technical questions all enter into the governance issue, and require hard thinking and difficult choices for an effective resolution of the problems these questions entail for effective and beneficial operation of the system.

Cost issues have major implications for detailed system design. Even though detailed system design and specification must precede any realistic determination of the price for constructing the network, there are significant cost issues to be faced. Because resource sharing is a major system objective, mechanisms to promote such activity become a major precondition of system effectiveness. Of the variety of access/assistance methodologies available, the implementation of a special "system currency" promises to maximize distributive benefits while minimizing unrealistic distortions of access rights or service provision. Where cost issues have the major role in forcing system focus is where the maxim "The best is the enemy of the good" applies most sharply. Where this factor descends from the theoretical to the practical is in the consideration of the trade-offs between system costs and system services which must be addressed. The final, crucial point at which cost issues have a clear priority in system design is the need to articulate clearly the benefits for all participants in the system if the necessary motivation for global network success is to be forthcoming.

Interface issues, more than any other general issues, require some very explicit preconditions for the architecture of the system. The fact that a variety of interfaces is needed in the global network simply reinforces the degree to which the interface issue will predominate. There are a variety of interface obstacles to be overcome, ranging from communication barriers, through the variety of information services to be linked and the scale of publication to be referenced, to the issues regarding transfer of information from developed to developing nations. Many of the interface problems which the global network must face are already part of the methodology of interface design; here the problem is one of specifying the exact tasks to be accomplished and matching these with available solutions. The fact that the recipients of information may differ markedly from its generators in their capacity for using it and in their acquisition habits is another major interface issue. The variety of interface problems in fact forms a continuum from the high-resource requirements of the global node, which can be specified and filled with comparatively little new intellectual effort, to the require-

ments of the national nodes, which—while not overwhelming in terms of their resource requirements—demand unprecedented levels of design sophistication to assure success.

As variable as the interface issues promise to be, the educational issues which must be met if the system is to function with any prospect of success are equally varied. In this area, however, the available resources closely match the requirements of the system, since information-management technology transfer has been an ongoing concern of the library and information service field. There are two general issues which must be addressed: training for system operators and education for system users. In both cases, the spectrum of available educational capacities range from the sophisticated to the non-existent, and in each case, a general framework for development can be specified. Operator training must proceed by way of cadre formation, with the long-term objective of extending the educational infrastructure from the developed countries to the recipients of educational aid. A variety of model mechanisms for providing such educational opportunities already exists and the major task to be faced is in negotiating the actual educational packages. Insofar as user education is concerned, the major role of the United Nations will be to train the trainers, in preparation for maximizing the impact of new systems in recipient nations. Capacities for contracting out such educational packages must be explored, flowing from a needs study which determines who can benefit most from the services the global system has to offer.

Introduction

> *We must bear in mind, then, that there is nothing more difficult and dangerous, or more doubtful of success, than an attempt to introduce a new order of things into any state. For the innovator has for enemies all those who derived advantages from the old order of things while those who expect to be benefitted by the new institution will be but lukewarm defenders.*
>
> Niccolo Machiavelli, *The Prince*

The purpose of this paper is to help stimulate debate on a series of important issues which have significant implications for the establishment of a global scientific and technical information network. Given the breadth of the subject, the discussion cannot be definitive, nor can it be rigorous in any analytic sense because the arguments presented must be compressed for ready access to serve as foci of discussion. When an argument is thus compressed much of the meaning is lost, although its basic significance may not be.

Prospective readers of this presentation must also realize that the discussion presented takes as "givens" many items which appear in the unpublished paper "Building a Global Scientific and Technical Information System", prepared for the United Nations Centre for Science and Technology for Development (UNCSTD). This paper was prepared in response to a recommendation by the Vienna Programme of Action to explore the feasibility of establishing an information network to meet the particular needs of developing countries. Such a network would operate as a channeling mechanism facilitating contact between users and suppliers of information with a global focal point in the network able to provide information to national focal points. Repeating even a summary of that document (which in itself was a form of summary) would have lengthened the current piece inordinately. Readers interested in investigating these underlying assumptions are referred to the UNCSTD document. This means many important and significant issues for the global network which are addressed in that document are not covered here, such as sources of information, modes of information dissemination, national networks within the global network, access, and network configuration.

A number of aspects of the discussion are troublesome because they introduce "noise" and this should be understood from the outset. In particular, precise definition of such terms as "information" and "interface" are difficult because some terms mean many things, and distinctions amongst the variety of meanings cannot always be established with precision. This has led to a few inconsistencies, but the authors do believe they weaken the case presented. In many ways, the problem with these definitions is related to Herbert A. Simon's observations about the computers and automation which underpin modern information systems:

> Computers and automation have captured men's imagination. This is to say, like the psychiatrist's ink blot, they serve the imagination as symbols for all that is mysterious, potential, portentous. For when man is faced with ambiguity, with complex shadows that he only partly understands, he rejects that ambiguity and reads meaning into the shadows. And when he lacks the knowledge and technical means to find the real meanings of the shadows, he reads into them the meanings in his own heart and mind, uses them to give external shape to his private hopes and fears. So the ambiguous stimulus, the ink blot, becomes a mirror. When man describes it, he depicts not some external reality, but himself.

In short, while the authors have tried to be consistent in using specific terms, the essential complexity of reality has affected the success of such attempts.

The range of topics to be addressed in the planning stages of a United Nations' global referral network is dauntingly vast, but the effort must be made. As Denis Norman, Zimbabwe's Minister of Agriculture has trenchantly noted: "Most of our problems could be resolved if we just had more knowledge". Nevertheless, so extensive is the scope of this project that no inventory in this field can ever be completed; new difficulties will continually arise. This is the "nature of the beast". However, it is not necessary that a definitive inventory of the issues be available or complete before a detailed feasibility analysis begins. If a reasonably complete enumeration of the major operational problem areas is arrived at, this should provide an adequate starting point for a sound discussion and a preliminary planning/feasibility study.

In the context of information systems development, the nature of any set of "givens" is such that (as a glance at Table 1 in this report reveals) specific items can always be combined or rearranged. To paraphrase Anaxagoras, there may not be anything new under the sun; but there surely is a lot to be said for the thought that everything may well be the product of rearrangement. It is therefore important to place the pieces of the information puzzle on the table, regardless of the risks involved in interpretation (given that information referral and communication activity represents an area where individual excellence is a co-efficient of interest and intelli-

gence, neither of which the network can *directly* supply); thus it helps one to determine the iterative combinations needed to shape the goals of the system. In many cases, though, results arise which produce statements which are almost clichés that is simplified, stereotyped representations that have lost the originality and impact of some of the ideas they summarize. Clichés complicate and confuse effective consideration and analysis. They confuse because they obfuscate and over-simplify the nature of the problems to be solved. This occurs because they are half-truths, containing much that must be disregarded but equally important, much that cannot be ignored. This is unfortunate but inevitable given the pervasiveness of the subject in contemporary society.

This position paper is intended to identify five problems which have priority in the system design of a global network: issues regarding information division, governance, cost, interfaces and education. What the authors have attempted to do is to highlight for discussion some of the more important problems which have to be resolved before implementation of the global referral network can proceed. By intention, this paper raises more questions than it answers. Finding solutions to these problems represents a fundamental part of the detailed planning which must precede implementation.

One final caveat about the structure of this paper is required: it is neither hierarchically structured nor analytically rigorous. No problem-solving hierarchy is possible in the absence of a development priority first set by the authorities who are in charge of network development. It also should be realized that the categories developed in this paper, while handled in separate sections for purposes of analysis, are not mutually exclusive. Each set of issues has aspects which also relate to one or more other issues. For example, the issue of information division is in part driven by economic issues, that is, cost. Similarly, one aspect of the cost issue relates directly to the issue of governance. Governance is directly concerned with the establishment of interfaces. All of these topics are reflected in the educational issues, which must be faced if the system is to operate, but which in themselves have cost implications. In the discussion which follows, this interdependence is noted wherever possible.

Information Division Issues Applicable to the Global Network

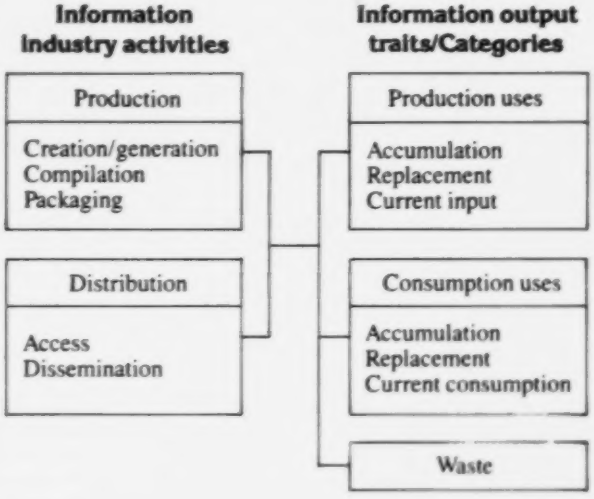
Since the global referral network has information as its stock in trade, issues relating to information itself become of fundamental importance. Where information is taken as equivalent to communicated data, we must establish the types of information which exist, their characteristics, how these affect (and are affected by) transmission functions, and the subject priorities the global network will set. This raises a very complex set of issues, which can be simplified only slightly by the realization that dollar values can be used, albeit with major limitations, as a common *numeraire* for expressing these considerations. Production and distribution then become essentially a matter of handling the flow of information, which is disseminated at cost. In the information and communication arena, we are beset by externalities and by intangibles. Cost, at least, if taken as a resource commitment, *is* tangible, and is as close as you can get to a quantifiable measure for evaluating an information delivery system.

In considering the issue of information divisions Fritz Machlup has isolated alternative aspects to the flow of information as follows:

> *Accumulation:* the information flow which increases the knowledge stock of society.
>
> *Replacement:* the information flow which offsets other information which has been removed from the knowledge stock.
>
> *Current input:* the information flow which serves the current production of other goods and services but is not intended to do so in the future.
>
> *Consumption:* the information flow which services the current enjoyment of its recipients.
>
> *Waste:* the information flow which has none of the above effects.

It is possible for a given information flow to have more than one of the above traits. Which trait is examined at any given time will be a function of the information system, its environment, and its suppliers and users.

The National Commission on Libraries and Information Science in the United States has noted that information is exemplified by *resources* (the information stock and facilities from which information products and services can be derived); *product* (discrete information packages developed for specific uses/users); and *services* (means of manipulating and transferring information to meet user requests). All of these are relevant to the United Nations global referral system, and are realized through information industry activities. These activities, in turn, can be characterized as creation/generation, compilation, packaging, access, and dissemination. Although the information characteristics of each of these activities is different than can be mapped according to Machlup's categories as shown in the accompanying figure.



Taking this conceptual map as a starting point for evaluating Machlup's categorizations, of, and assessing their implications for the global network can give a better picture of the process as a whole and of its constituent pieces.

Some information, for example, is effectively free, resulting simply from people's conscious interaction with their environment (e.g. that proceeding from social relations via conversation). Such information is subjective because it is

individually internalized as Machlup notes; is usually regarded as a free good; colours popular attitudes regarding information as something "free". (As anyone involved in the so-called free public library movement throughout the world can tell you this attitude has proved very costly.) Even those cases where the use of information affects the results of production, the profits realized from the use of information may not be explicitly recognized because those profits are subsumed in overall profits from production (although these costs might be sorted quickly out if there was a demand for the information activities as independent products). Since information costs are often subsumed in other activities and many information activities do not directly generate a profit, it is difficult to assess much information activity that has consequences in the production process. Similarly, hard and fast characterizations of information may not be possible because the categories may be a function of use. Information which for one is accumulation may be replacement for another and waste for a third, with different costs and values as a result.

However, in many other cases, the costs of information (and their effects on the creation of different information types) are explicit and direct. In North America the emergence of a distinct information industry has been recognized, providing products which exist as discrete cost items because people are paid for these services (although in the case of organization services, like data bases, the payment may be at second or even third hand). When we move beyond subjective information and production-consequential information we then consider information as a consumption item. Finally, we must recognize that some information or information activity ultimately must be classified as waste.

In all cases, the classification may be directly related to timeliness. This is particularly true for what is classified as wasted. Some information must be available in time for it to be used at all (e.g. television schedules). Consumption items may not have such specific deadlines, but they are not intended to endure, whereas investments in information accumulation are expected to yield relatively permanent returns. Similarly information as replacement or current input may depend fundamentally on timeliness for its value (e.g. last week's exchange rates are of little or no value to a money trader today). Thus, insofar as the global network is concerned, it becomes important to distinguish among information types and the characteristics which determine these types, since the ease and cost of accessing each type will differ, even for referral purposes.

A key distinction which must be made by the global network is that between cost and value. As Machlup has noted: "Values are based on expectations ex ante, not regrets ex post". Many writers have used cost and value as completely interchangeable terms, but this is clearly fallacious. The specific relevance of these distinctions for the global network can be seen in a simple example. In many cases the cost of the information that the network accesses will be negligible (by referring to something published in the public domain, for example) yet the value for the recipient may be very great indeed if it contains the answer being sought.

An additional consideration to be distinguished is benefit. The same information may benefit either the recipient or others. Insofar as the benefits are not retained exclusively by any single user (as is the case, for example, when you eat a piece of bread), the value of the information cannot be equated to any one individual's benefit from the information. Information, like most economic goods, is not diminished by use, per se. More important, when individuals do retain exclusive use of information or when through ignorance or lack of access information is not known by all who might benefit, its value could be increased by making it more available.

This gives added impact to the point made by Edward E. David Jr. when he relates troubles in getting industrial research and development (R&D) "out the door" to the "commercialization phase of innovation". If output gains in the immediate environment will not cover the marginal costs of the activity which research and development makes possible, it will not be undertaken, even if the research work which established the possibility has been done and paid for. A major concern of developing countries is the relevance of existing research and development. If research work of potential use to developing countries does not find applications in developed countries, then there is no return on that research and development, and the research work cannot get "out the door". Being able to identify such research work would permit the developing countries to mobilize initiatives for the application and dissemination of such information.

Another useful way of looking at the information division issue is to consider the broad categories of information with which the global network will have to be concerned:

> Information which is an end in itself e.g. information arising out of pure research;
> Information which facilitates some other end e.g. applications of techniques for industry or agriculture; and
> Information which serves as an organizational component e.g. the implementation of record keeping for government departments.

Each of these information types might differ depending on originator or creator. Each of these three categories will have a variety of producers: industry or other private corporate entities, universities, governments or private individuals. In addition, within each group of producers, information may function as a resource or a commodity. Finally, within each function type, information may be proprietary or unrestricted. All of these characteristics will have implications for the global referral network.

Although the combinations provided above give rise to more than one issue apiece, insofar as planning for the global network is concerned, a major issue can be associated with each for illustrative purposes as displayed in the accompanying table. In relation to these issues, access to the global network is predicated on overcoming the specific problems within the global network design or as a consequence of the availability/accessibility of the global network.

In addition to the issues of information types which the global network must handle, important issues also arise from the communications activities which the network must facilitate. The first of these relates to the rapidity with which information is provided. Clearly there is some lower limit below which delays in response will render the network useless. There may also be an upper limit on rapidity of service resulting from increasing costs. The issue to be faced directly is the degree of trade-off which will be required. Similarly, given the vast range of information which must be handled, the initial stock of information in the system must be considered with some care. In the case of certain sciences, the bias for immediate and rapid information results from the nature of these sciences in that they engage in continual revision of

theories and therefore practice. In such sciences, questions of "leading edge capacity" and "technological breakthrough" are real and pervasive considerations. To the extent that the global network handles such sciences (of which perhaps chemistry might initially be the most important), a fairly narrow base will be required (for reasons given in the unpublished UNCSTD document mentioned earlier), to be revised and updated frequently. Other important sciences relevant to the global network, however, like agriculture and forestry and observational sciences, characterized by a much more enduring and stable information corpus, which does not usually mean that the latest research invalidates the lessons of the past. For these sciences, the global network requires a much broader information base, but one which will require less updating, less often.

Another aspect of information division which results directly from the differing characteristics of the subjects with which the global referral network must deal is that of timeliness a subject dealt with earlier in this paper, a different context. To paraphrase Ranganathan, the global network must deliver "the right information to the right user at the right time". Some information needs quick transmission in order to be useful (e.g. a medical diagnosis or a closing quotation on the stock market). Other information (e.g. a specific agricultural reference) is far more "durable" and much less likely to be urgent. In some cases, issues of information timeliness can be met with proper scheduling (in the stock market example, the exchange closing time is known, so the information can be fitted into the proper time slot), but where the referral system is primarily a demand system, this issue is relevant to the internal architecture of the network, covering such matters as arranging for priorities in information transfer and issues such as whether the system or parts of the system should operate in "real time".

Reliability of transmission is another issue to be considered. As regards the overall system, cost and reliability, speed and reliability, and cost and speed are trade-offs. The trade-off between speed and reliability is rapidly disappearing in the newest, most sophisticated computer-based systems under the impetus of advances in "chip" technology. This is also increasingly true of cost and reliability. Cost and speed may soon be the biggest remaining trade-offs. Nevertheless, the basic objective of at least minimal system function must be met, and within that minimum, additional emphasis must be placed on the issue of reliability. In many cases, relatively unsophisticated system users will have levels of expectation which can vary widely with results. This means that to the maximum extent possible "teething" troubles in experimental systems must be overcome prior to the initial general offering of the global referral service. Once users have come to rely on the system, they will evolve additional demands which then must be assessed in the context of system improvements.

We are faced here with an issue which is as old as information services themselves. In ancient times, scarcity of sources meant that user/source interactions had to be limited and specific: one-on-one. The evolution of mass media and telecommunications resulted in a proliferation of sources coupled with a multiple, general access capacity which nearly eliminated specific information interactions many-on-many. The continuous development of special purpose computer/communication-intensive information services restores the individuality of ancient systems coupled to the resources of mass communication one-on-the-world. Effective realization of the potential inherent in this development calls for exact and demanding system design.

The final set of information issues to be addressed concerns the subject priorities to be established in the system. T. K. S. Iyengar has made this point most cogently when he notes that information service areas must be relevant to Third World populations. His categories seem most reasonable as an initial base on which expansions can be built:

Natural resources	agriculture for food production agriculture for clothing production water resources: consumption/irrigation fuel building materials
Energy	most easily used natural resource
Health	preventive medicine environmental hygiene potable water supplies effective, non-polluting sanitation systems
Employment	agriculture food processing building industry textile production low-technology tools and utensils production

Of course this list represents just a beginning. Numerous additional candidates for system inclusion can be specified, including market information, shipping information, news, "cultural" programming, security systems, and financial services. Obviously, lists of desirable system contents could be specified at great length. What the examples given make clear is how what is desired will influence what can be developed. This final information division relates directly to user needs. Ultimately, every information system is only as good as its users. Any system worth supporting must meet actual (as opposed to perceived) user needs; be accessed, addressed, and maintained both physically and intellectually on a reasonable basis; be relatively inexpensive and be operated in a cost-effective manner and allow for significant local manipulation and adjustment.

Such aims are difficult to achieve in any global system because of the multiplicity of user needs which will be involved. Defining such needs will probably require a definitional process which is both iterative and modular. When regarded in totality, the diversity of information issues which the global network must face makes parallel investigation at both practical and theoretical levels the only effective means of addressing these issues.

Governance Issues for the Global Network

The global network concept will be subject to a variety of competing interests and claims demanding resolution if the network is to move from concept to reality. This is what the term *governance* means: the way(s) in which these competing interests and claims are resolved i.e. the way in which the network operates or is governed.

A first principle which must be recognized and accepted before the issues at hand can begin to be resolved is that the concept of governance as it relates to creating and operating a successful global scientific and technical information system rests on the fact of global interdependence. Co-operation

Table Information types/issues matrix

Users	End Use		Facilitation		Organizational	
	Resource	Commodity	Resource	Commodity	Resource	Commodity
Industry						
Proprietary	Ownership rights	Audience targeting	Applicability	Patent law	Capital cost	Specialization
Unrestricted	Inertia	Competition	Access	Relative value	Packaging	Timeliness
Universities						
Proprietary	Scarcity	Selection	Precision	Availability	Lack of system	Inchoateness
Unrestricted	Disciplinary	Organization	Intellectual	Inefficiency	Working models	Vendor weakness
Government						
Proprietary	Official secret acts	Sovereignty	Capacity	Direct intent	Routine	Mandate
Unrestricted	Resistance from object	Political bias	User Suspicions	Interest	Portability	Complexity

Note: This is an example of a matrix which may help to shed light on specific issues. As explained in the introduction, the final interpretation of this or any other matrix classification will depend on the particular vantage point taken.

with respect to the flow of information is therefore necessary for there to be any mutually beneficial advance of countries. Countries which proceed unilaterally are likely to gain only in the short run (if at all); in the long run, unilateral action will defeat everyone's interests.

Given this first principle, what are the issues to be resolved? For purposes of convenience and space, this discussion expresses the issues primarily in the context of developed versus developing countries. That this is an oversimplification for analytical purposes must be recognized. There are (and will be) particular individual countries within both of these broad categorizations that have interests which do not conform with the general patterns presented here.

It is a fact that at present most of the information technology of the world, both hardware and software, resides in the developed countries. As A. Neelameghan has noted:

> Over 90% of the capacity for generating, communicating, and utilizing information and knowledge, especially in the fields of science and technology, rest *sic* with a small number of technologically and industrially advanced countries (some 30 countries with over $800 per capita income and sharing 35% of the world population burden) and, therefore, the developing countries (about 120 countries with less than $500 per capita income and sharing over 60% of the world population burden) have either to provide the knowledge and the know-how, for example, in the form of books, periodicals, reports, patents, specifications, accessing remote data bases, licensing arrangements, training, expertise, and commodity import, together adding up to a sizeable amount and resulting in an unfavourable foreign exchange and balance of trade situation, or alternatively, they have to duplicate and develop such technology indigenously, at great cost.

It is also a fact that the developed countries are already relatively well served both internally and externally by information networks of various kinds, both private, commercial networks and public networks. Developing countries lack both technology and access to existing networks, by comparison to the developed countries.

Much of the rationale for the global network is based on the desire to remedy this present imbalance. But this should not mean simply importing the technology of the developed countries into developing nations. Nor should it involve merely expanding the market base of existing networks in developed countries to encompass developing nations. If the global network is ultimately to be of maximum benefit to all nations, then it must go beyond this kind of simple transplantation.

At the outset, given existing disparities in available information infrastructures as well as other considerations such as cost, the measures deprecated in the paragraph above may be a necessary way to begin. But in the long run, the concept must work toward full participation by all countries. In each case, besides using the information the network makes available, network participants must be involved in the creation and organization of the information as well.

For developing countries the logic of this argument is clear. For economic, social, cultural, and, political reasons, developing countries cannot ultimately rely on an information network in which the flow of information, the flow of technology, and the control of information are all in the hands of developed countries.

What is perhaps not quite so apparent, but nonetheless true, is that a system dominated in all details by the developed nations is not in their long run interest either. If the system fails, over time, to meet the concerns of developing countries, they will drop out of the system and seek to develop their own alternatives. Only if the concept is born in commitment to co-operation and a *real* sharing of control, information flows, and technology, will the developed countries reap the long-term gains inherent in the global network concept.

In addition, the information created or organized in developing nations could be of direct benefit to developed nations in many ways: exposure to new cultures, experience of new sources of economic and political information, awareness of new forms of social and professional interaction. These all represent potential tangible benefits to developed countries from the creation of a truly global information network.

There are other issues which are important and which must be dealt with in the governance of the global network. They include strategic concerns of countries or alliances, political sovereignty concerns over transborder data flows, choice of transmission technologies, potential threats of interruption/disruption of network access, bilateral restrictions on information exchange, and cultural sovereignty concerns. All of these are important issues. Space forbids a detailed discussion of all of them here. Recognition is important, however, that the concerns of individual countries regarding these issues are legitimate ones. Equally important is the recognition that it is in everyone's interest to seek co-operative solutions to these problems. Such solutions must be embodied in the design and execution of the global network concept.

There are a number of existing models for dealing with these issues which should be examined in detail as part of the planning stage for the global network. Some of these models are national ones i.e. an individual country's national "informatics" plan while others are co-operative (bilateral or multilateral) strategies. There may be important lessons to be learned from all these examples, and all should be investigated.

The issue of governance also has an internal intra-country dimension as well as the external inter-country dimension we have been discussing. The way in which a country's internal network is governed will have major implications for the level and distribution of the benefits it receives from the global network. It will also, however, have direct implications for the global network since internal governance will also influence, the ability of individuals (as opposed to countries) to communicate, the development of indigenous data bases to all parts of the network, the levels of known use, network interface requirements, costs and prices and other unspecified issues. This does not mean that the co-ordinating agency for the global network should try to impose on participating countries any one fixed model for internal governance. It does mean that internal governance procedures are a necessary datum for the proper planning of the global network.

A very important issue in governance relates to the financial dimensions of the network: costs, cost recovery (including prices and price structure), and cost shares, especially as between developed and developing nations.

Financial issues are discussed in more detail in the next section of this report, dealing with cost and cost recovery. The point to be noted in the current context is that the financial framework surrounding the global network is one of the key aspects of the whole governance question. The success of the network will depend to a very large degree on a satisfactory solution of the issues of financing and financial structure.

Finally, the governance issue must address itself to a variety of legal/institutional questions. Some of these emanate from more general issues already identified, such as national sovereignty concerns or strategic considerations. Others relate to the internal institutional character or structure of countries. These must be treated when taking internal governance issues into account in the planning of the global network. Still others are issues in their own right, such as, for example, the problem of copyright or of more general property rights.

This latter issue is a particularly important one for an information network, since it relates directly to the information division issues mentioned in the previous section of this report. Such an issue becomes especially important in relation to governance if the network is, in any substantial way, build around a computer-based system. Information, by its nature, in a pure form, at least does not lend itself to a property rights assignment in the way of private goods. The particular way in which information is collected and organized, however, can include a property rights assignment. Such an assignment can be very difficult to enforce, especially if the data are computerized. The potential for copyright violations represents a very real problem; a particular variant of the more general property rights problem regarding information. This problem can be dealt with, in nominal terms at least, by internalizing it within a particular institutional structure such as the global network. Nevertheless, the rules (and therefore the governance) under which this issue is internalized remain an important issue to be dealt with.

Governance, then, is a virtually all-encompassing issue which embraces the entire range of rules, regulations, procedures, structures, and institutional arrangements governing the global network. It rests on an *a priori* assertion of the necessity for co-operation in the creation, dissemination, and control of information in an increasingly interdependent world.

Cost Issues for the Global Network

One of the most obvious difficulties in discussing issues of cost and cost recovery for the global network is that the very concept of the global network is still to be defined in precise terms; and should, in any event, be seen as a dynamic concept.

The dynamics of the global network must allow for differences in the national network component in different countries, for different levels and types of use by different countries, account to be taken of different starting positions regarding the information and communications infrastructure already in place in various countries and provision of a gradual evolution/development of network components and content areas.

The difficulty of specifying costs when the concept has yet to be defined with precision is obvious. The problems arising out of the dynamic properties of the network should be equally obvious. Existing levels of communications infrastructure development, for example, will have major cost implications (whether front-end or spread out) for bringing all countries up to levels which they are capable of efficient interface with the global network. Or it may be that differences in existing levels of communications infrastructure will dictate different national-level models of interface, each of which will have different implications for total system cost.

In a similar vein, how the system is structured and what it contains, as well as how these concepts evolve over time, has major implications for the cost of the network both now and over succeeding periods.

The list could go on. The conclusion, however, is already evident: until the global scientific and technical information network is translated with some precision into operational specifications, the issue of costs cannot begin to be addressed in actual monetary or real resource terms. Even when such a precise specification is forthcoming, costs will still be uncertain a function of the dynamic properties and the evolution of the network over time, the resources available, and the demands (or needs) of the users to be served.

Notwithstanding these caveats, some general issues/observations relating to cost and cost recovery can be offered for consideration:

1. The objectives established for the global network will have primary implications for cost and cost recovery.

2. A major long-run objective of the system is assumed to be to maximize access at both the national and subnational levels.

3. Accepting the above premise means that cost must be defined not only in terms of data bank creation (the creation/organization of the information) and the cost of the information itself, but also in terms of the cost of accessing and using the information to be supplied.

4. The implication of the second assumption above is that, on the cost-recovery side, account must be taken of the differing ability to pay on the part both of countries and of interested parties (i.e., individual user groups) within countries.

5. It follows from this that the system of cost recovery cannot be based on the principle of full-cost recovery by individual user.

6. This does not mean, necessarily, that a system of usage-based charges is ruled out; it does mean that such a pricing system, if used, cannot, by itself, support the total network cost.

7. If the system cannot be supported by a full-cost recovery system, then some subsidy of the network must occur, either in the form of direct contributions for either capital or operating costs or through some form of cross-subsidization built into the pricing scheme adopted.

8. The cross-subsidization option, in principle, is not preferred, because such schemes create distortions in usage patterns, creating a gap between need and use.

9. If direct subsidies are to be used, two problems arise: first, who is to provide these subsidies and in what form; and second, the need to devise a suitable means of prioritizing user-demands on the system, i.e. the need to solve the queuing problem for access, which otherwise would be handled by the pricing scheme alone.

10. Options to be considered for setting access priorities include:

(a) continued reliance on a price mechanism, even though price levels are set below the full-cost recovery point. This would provide a less than perfect answer, as the artificially low price levels would still lead to uneconomic demands on the system.

(b) a negotiated agreement on some priority-setting mechanism. This would raise new problems relating to the difficulty of enforcing such an agreement.

(c) assignment of quotas by country. This would leave unresolved a method of determining national priorities, and would suffer from the potentially arbitrary quality of any quota system, which may leave the size of quotas for any given country out of line with need.

(d) creation of a "coupon" or special, non-convertible "currency" system to be used as the means of direct payment for use, coupled with a pricing scheme which is usage-sensitive and pricing levels which are commensurate with nominal full-cost recovery. Various options could be used for allocating this special "currency" among participating nations: an allocative mechanism along the lines of that used by the International Monetary Fund for SDRs; a purchase scheme that sets different prices for different countries; or a tier system that provides a base allocation free or at a nominal charge and further allocations at higher prices, perhaps progressively higher prices.

11. The special currency system method for determining access priority has the following advantages: once allocated, the currency becomes a real resource—countries will have to deal with their own internal priorities in assigning the allocation amongst subnational groups; the arbitrary element of straight quota allocations can be solved by setting terms for countries to acquire additional "currency" allocations; enforcement issues likely to be encountered under negotiated rules of access can be internalized to countries; and the "uneconomic demand" problem would be largely solved because of the real resource properties of the special currency, once acquired.

The preceding list of considerations is neither an exhaustive nor a definitive discussion of cost and cost recovery issues for the global network. It does set out some major assumptions and delineates certain major issues, however. These will require careful consideration in the planning stages of the global network concept.

Three additional issues deserve some mention in concluding this brief outline of the major issues of cost and cost recovery for the global network.

First, a clear distinction exists and is important to emphasize between ultimate costs and initial or front-end costs. While the ideal global network, in terms of configuration, universality, content, and technology, may well be prohibitively expensive at the outset, this ought not be a deterrent to action. One can start with something far less than the ideal, which is nonetheless highly beneficial, and then over time, as resources permit, work towards the ideal.

Two caveats must be noted here, however. At the outset, the particular starting point chosen and the successive increments to the system over time must be carefully evaluated to ensure that they deliver maximum benefits for the resources involved. The theory of "second best" tells us that not all possible systems consistent with a given resource commitment are necessarily equal. Additionally, in making incremental changes to the system over time, there may be indivisibilities in the technology (either hardware or software) which require larger changes than might otherwise be desirable. This may influence the timing of changes or the cost implications of changes, or both.

Second, and following in part from the preceding paragraph, is the importance of recognizing that there is a trade-off between function and cost for the global network. The less the system does, the more limited access to it is, the slower the response time in the system, and so on, the less the system will cost. This may seem a trivial observation, but it is worth emphasizing because all too often it is overlooked, however trivial it may be. The network, when in place, will do only as much as it is made capable to do; the latter will be a direct function of how much is spent on it—what it costs.

Third and finally, there has been an implicit assumption in this section that the subsidies essential for the system will come from developed countries. It will be important in the detailed planning of the global network to take proper account of the potential benefits to developed countries as well as to developing countries. If developed countries are to pay a disproportionate share of the cost of the network they will need to be convinced that it is in their interest to do so. In the process they must also be convinced that it is not in their best interest to insist on a structure which leaves all the sources of information and all the resources of information storage in their hands. In the section of this report dealing with governance, some of these issues were discussed at a more conceptual level. The point here is a very pragmatic one: the global network offers the potential of benefits to all, but this potential cannot be realized if the concept falters for lack of finances. Some (mainly the developed countries) will have to pay shares that are disproportionate (relative to their direct use) or the system will falter. If it falters, all will lose.

Interface Issues for the Global Network

The role of the global referral network as an intermediary among a wide range of information service needs, information storage centres, and information use capacities requires a separate discussion of the interface issue. The notion of "interface" itself has become sufficiently broadened from its initial meaning—a common boundary surface between two bodies or spaces—so that some specification of what the term means is desirable. The primary meaning of the term *interface* in the context of the global referral network is that aggregation of outflow, machinery, and routines which enable the separate network segments to interact with one another. In a broader but more important sense, interfacing for the global network refers to access—*how* you connect people to the network and *who* will be connected to the network. In considering interface issues for the network, attention must also be paid to those areas which are affected by interface particulars, even if these are not themselves interfaces.

For the global network four different levels of interfacing must be considered:

- between the global node(s) and United Nations resources and other extra-system, world-wide information system resources;
- between the global node(s) and regional nodes, as well as interfaces among the latter;

— between the global node and the national node, as well as interfaces among national nodes and between national nodes and regional nodes; and

— between the national node and the national information system, as well as interfaces among sectors and individuals and the national node.

The interface issue has wide implications which must be clearly recognized at the outset. While other elements in system development do not dictate the architecture of the system or the functional elements which it must employ, the following discussion (based on the unpublished UNCSTD document above-mentioned) makes some fairly detailed assumptions about the mechanisms of the global network.

George J. Stigler has noted that the cost of information collection (while real) is virtually independent of its use and numbers of users, whereas the cost of dissemination is dependent on use and number of users. Since interfaces represent the mechanisms which enable information to be disseminated among users, interface choices will determine system functions. Fritz Machlup has given added point to the interface issue by observing that choices are often necessary between new information in the heads of a few and old information in the heads of a greater number. In many cases this sort of choice will be a political one, with no necessary connexion between cost and benefits, particularly in the short term. Exactly how the global network is to function in relation to this issue will determine the form of interfaces which will be used within it.

T. C. Bearman has raised another consideration relevant to the interface issue by specifying a variety of barriers to the international information flow which the global network is designed to facilitate: tariffs and discriminatory pricing, monitoring of information transmitted via international data networks, restrictions on marketing through government regulations, and denying market entry to foreign-owned enterprises. While some of these barriers may operate with less force against the United Nations system than against information flows in the private sector, these barriers do represent substantial disruptions in operations and efficiency. Such disruptions increase the human and financial costs of the system to all participants. From the perspective of an individual country, then, they may reflect quite legitimate concerns. However they are resolved, they are factors which the interface design must address.

Why the interface issue is important to the global referral network has also been expressed by Bearman in terms of the information environment in which it must function. She has established how information in scientific and technical areas has proliferated almost beyond control: the worldwide publication of scientific and technical journals can be estimated in the 40,000 to 50,000 title range. This proliferation of materials has developed through successive information service eras: (a) discipline-based services, (b) mission-based services, (c) problem-based services, and (d) individualized, custom-tailored information services. The significance of this continuum of information services becomes clear when we consider that, as the service spectrum evolves, individual actors in it change their orientation and thus the value of their information assets. This means that the interface between organizations and systems at different information-service levels must take such orientations into account.

It is axiomatic that a dispersed information network must be communication-intensive. The nature of the global referral network, which is predicated on access to (and ultimately creation and extension of) additional large computerized reference data bases, makes the global network computer intensive as well. Indeed, the proposed global network is itself an interface between high-technology global, regional, and national levels and other systems at national and sectoral levels which may not be technology-intensive. Such a hybrid system raises many interface issues:

— Can such a system work?
— Would it be efficient?
— What other options exist?
— What are the cost implications of the options?

and many other questions. However these issues are resolved at the national and sectoral level, UNCSTD has accepted a computer intensive network as a given at the global level.

This characteristization of global referral network interfaces thus justifies the consideration of a number of general system interface issues. R. S. Marcus and J. F. Reintjes, among others, have identified the following technical requirements/concerns:

1. Access to several different systems for search completeness;
2. Selection of appropriate sources from the multiplicity available;
3. Use of different physical systems for access;
4. Differing cost and payment mechanisms;
5. Differing command languages for system function;
6. Differing retrieval functions among the systems available;
7. Differing indexing languages; and
8. Differing output formats.

While in theory many of these difficulties may be reduced through standardization, in practice standardization is impossible. For the global referral network, careful interface design must compensate for such lack of standardization. The interface must function as a common system into which and from which results and requests are translated automatically as they flow between user and serving system.

Of course, the interfaces for the global referral network are of a particular type, namely, information system interfaces. A. Neelameghan has developed a useful check-list relevant to technology transfer to developing countries:

1. Appropriateness of purpose;
2. Appropriateness to user's characteristics;
3. Appropriateness to the application environment;
4. Appropriateness to the medium of information transfer;
5. Appropriateness with respect to quality;
6. Appropriateness with respect to terms of availability;
7. Appropriateness with respect to economics and cost.

In many cases it is not the proper function of the interface to assure that the information transmitted across it meets these criteria. However, a major consideration in interface design must assure that the interface activity is never the appropriateness of the information.

Since the global referral network is specifically intended to assist growth and prosperity in developing countries, a vari-

ety of specific determinations need to be made about users and information for interface purposes. It would be a potentially costly mistake to assume that scientific and technical information referral/retrieval systems and methods in developed countries can apply in developing countries without any modification. T. K. S. Iyengar has suggested we need to identify the different categories of users, their information-seeking behaviour patterns, and their capabilities for information assimilation, as well as the application of information to different tasks in the developing nations. The relevance of this to interface issues becomes clear when we realize that most of the current internal information services reach only about 10 per cent of the people in developing nations. Iyengar puts his finger on a crucial factor in the interface issue when he notes that in developing countries, information has to be secured and filtered for transmission to users in three categories: specialists, literate laymen, and illiterates. While the initial bias of the global referral network must of necessity be to the first two members of this potential audience, interface designers must bear in mind the third group, particularly if information delivery is contemplated as an evolutionary goal for the network.

In many cases, the interface for access to the global network must take account of the target audience's technological sophistication. Adaptation may be required on the part of the network and the user alike. For the network the particular adaptation relevant to interfacing involves connecting up to quite unsophisticated distribution devices and systems. Since many developing countries lack any widespread electronic communication infrastructure, establishing such systems will be an extremely expensive proposition. In a relative sense, the costs of different distribution systems may be approximately equal, and, in absolute terms, extremely high. A significant portion of the distribution costs will involve appropriate designs for specific locations, coupled with the cost of the resulting interface requirements to allow these locations to function within the global network framework.

If the global network is to operate with sufficient speed to be useful, then it follows that at the interface above the national level, a high-technology means of communication must be employed. While alternative means for such communications exist (satellites vs. fibre-optic cable, for example), a choice among these communications technologies will have to be made fairly early in the system planning process. Similarly, for access to the large data bases needed at the global and regional level, quite complex computer programmes for search and retrieval will be needed.

These aspects of network planning highlight the issues in evolving network interface standards. The major point to be considered in this case is that standards do not necessarily imply standardization. The United States Library of Congress cataloging system services as an excellent example for the United Nations network, inasmuch as local users can apply a wide variety of "custom tailoring" to an established, well-understood base. Similarly, many technical standards for high technology information systems have already been established by the developed countries and interface mechanisms to make these standards compatible with one another exist or are under development. Re-establishing anything different for the global network at the outset would be prohibitively expensive and counterproductive. This means that the major system problem with the interfaces between the global node and other international information systems, global/regional interfaces, and regional/regional interfaces is cost, because the greater part of the technical work to create the environment in which these interfaces must function has already been done. In effect, available choices are severely limited by the technical means available, making the major effort one of developing the system functions and the protocols which will be needed for system stability and effective operation.

At the national level, on the other hand, the interface issue appears nowhere nearly as costly, but is considerably more complex. There are in fact two aspects of the discussion which must be kept separate: (a) the interface between the national node and regional and global nodes, and (b) the interface between the national node and the elements of the national information system. Although on first examination, both problems present extraordinary complexities, the requirement for rapid communications at the regional and international levels means that the range of communications equipment is considerably narrowed. In cost, complexity, and sophistication, the communication resources of the national node in its initial configuration will be considerably less than those of nodes with wider responsibility, but the technical requirements for networking will mean that the same form of instruments will be used. As for the computing equipment that will be required, the shoe is on the other foot. The machinery is going to have to be cheap and simple, or it cannot be used. Developments in microcomputers in North America and Japan hold great promise for effective interface development at this level and in this direction.

However, the interface between the national node and the elements of the national information system will be perhaps the most daunting intellectual and material problem which the global referral network will have to face. By their very nature, the diversity of communications capabilities, the sophistication of information access, and the information requirements will differ more markedly at the national level than anywhere else. Because maximum use of the existing hardware infrastructure is an unavoidable system specification, the technical means will vary widely. Because social and political attitudes regarding internal information dissemination will also vary, additional design complexities are introduced. When one adds to this the requirements for transliteration and translation, the task of effective interface design at the national level becomes prodigious. The unpleasant truth must be faced that it will not be possible to design this interface from scratch: it will have to evolve over time as application of the global network dissemination in each nation concerned proceeds.

Educational Issues in the Network

The success of the global scientific and technical information network will ultimately depend on the manner in which the cluster of issues relating to education in support of the system will be dealt with. The major planning aim of the educational effort that must be mounted and implemented is twofold: (a) to develop a cadre of scientific and technological information workers capable of establishing, maintaining, and developing the information infrastructure needed for national participation in the global network; (b) to develop a system of user education, as an integral part of the educational programme for the global network. In the case of the scientific and technological information workers, a thorough grounding will be necessary in a number of areas: standard

bibliographic routines, expertise in systems design, user interface, and methods of document delivery. In the case of the users, designing an attractive programme capable of motivating them to use the system and also training them to do it well will be a major creative task.

Of necessity, operator education and user education must be discussed separately because the "student bodies" involved have different attitudes and expectations, as well as different educational needs. Despite the analytical necessity of separating operator education and user education, and regardless of the fact that certain concepts relevant to user education can best be demonstrated through a discussion of operator education, no distinction in importance between the two educational efforts is intended in this discussion.

The preliminary point to be made in assessing educational issues is a simple one: the primary aim of the global network is to assist to developing countries. This means that needs, as well as mechanisms for meeting these needs, will vary—often dramatically—from country to country. It follows, then, that the greatest educational effort needs to be expended at the national level. It is probable that little if any systematic effort on the part of the global network itself will be needed in the case of the developing countries, although some briefing on the history and culture of the nations to be served would be in order. It is also apparent that the nations which intend to participate in the global network seem to fall into two categories: those which will need development of an educational establishment almost from scratch and those which can be assisted through the establishment of regional education centres.

Insofar as the training of scientific and technological information workers is concerned, the levels of training available in any given nation will fall in one of three categories: (a) training within sophisticated library and information service environments; (b) training within an environment featuring a basic level of competence in library and information service; and (c) training where no library and information science training establishment is available.

In the first case—the sophisticated library and information service environment—the primary role of nations in this category will be to act as a resource.

The educational format described thus far is biased towards information retrieval, since that will be the major function of the referral system as originally constituted. But the fact must be recognized that the referral system has as its ultimate goal the evolution to an information delivery capacity as well. In the longer run (particularly for the sorts of mutually beneficial interchange mentioned in the section covering governance) training in the "creation" of information will also be necessary. The educational focus for the global network will therefore shift substantially towards disciplines outside the library/information-service field, although the latter will remain an important component of network education. It is impossible at this early stage of discussion to determine with any precision the fields of study which will be involved in shifting relative emphasis toward the creation of information.

In many countries, training of scientific and technical information workers is readily available at the level of basic library and information-service competence. Given appropriate direction, persons trained at this level could provide the initial pool from which could be drawn those capable of implementing the global network plan. The major issue relating to such training will be the need to identify key personnel within the national library and information-service areas of the participating developing nations who can be upgraded to handle the global network tasks, and the countries in which this upgrading can best be done. It is clear that countries with sophisticated scientific and technical information services, e.g., the United States, Canada, Europe, and Japan, have a special role to play. A major related issue which will have to be met in providing of such training in the developed nations will be measures to ensure that graduates return home after their training period. This is essential because the best long-term solution is for the development of first-generation information cadres who will import sophisticated information-service techniques into their own nations, forming the nucleus for the training of additional generations of information workers.

Using the resources of the developed nations for the initial development of an educational system represents the fastest, cheapest, and most efficient method of diffusing such expertise throughout the global network. The initial development objective would be for fast forced-growth training programmes, involving short courses and periods of actual work experience in scientific and technical information facilities. What makes this approach attractive is the availability of underutilized institutions and the existing body of accessible expertise in providing such opportunities which is available in the developed nations. The United Nations, in support of the global network, could contract for services from organizations such as the Library of Congress, the National Library of Agriculture, and the National Library of Medicine, in the United States, Canada's International Development and Research Centre, and the British Council, in the English-speaking world; and their equivalents in other nations for non-English speakers—in particular, developing nations in Africa and South America which may prefer to work in French or Spanish. The particular advantage of this approach for the United Nations, beyond that noted above, is the potential for reducing start-up costs. It may also provide developed nations with an opportunity to provide such help as a form of contribution.

For countries which must start from scratch because they lack their own library and information service educational facilities (approximately one-quarter of the 120 nations designated as underdeveloped), a different approach must be taken. Since some equivalence is possible between the lack of library and information service training facilities and the lack of sophistication of information services generally, the nations in this category will need a two-step technique in educational development. First, efforts must be directed towards development of basic competencies. For reasons similar to those underlying the "expertise drain" issue, and also to provide education in an appropriate environment, arrangements can be made for work experience in information to be gained in appropriate neighbouring countries. In other cases, particularly where there are no appropriate neighbouring countries, domestic training programmes will have to be established with United Nations support. The major difficulty in the latter case will be maintaining a focus on global system requirements. Once the basic level of competence is developed in a given nation, the second step up to sophisticated information services can be taken.

Supporting the global referral network must also involve the provision of educational opportunities beyond library and information-service activities. Provision will have to be

made for the training of systems designers and computer specialists. While the global node can be staffed easily from the resources of the developed nations, it would be extremely desirable to broaden the mix of nationalities to the greatest degree possible. It will, however, be difficult to staff all the regional nodes from the same source, and both impossible and undesirable to staff the national nodes from developed nations.

It is worth noting that the level of systems expertise required for the global and regional nodes will emphasize systems of a very large scale, whereas a less rigorous level of small-systems expertise will be needed in most national cases. Similarly, the computer specialist requirements at the global node will have to encompass leading-edge high-powered computing and communications systems technology. At the level of the regional nodes, computer and communications expertise will be equivalent to the average commercial-grade installations in North America. In the case of the national node, mini- or micro-computing expertise will be most important, and many communications functions will be bundled with the computing machinery. To the extent that these units all interface with one another, some of the same basic competencies will be required throughout the system. At the national node level, however, the scale of technological research expertise needed will be substantially less than elsewhere in the network.

Depending on the equipment available, it may be both possible and desirable for some of the training of computer operators to be provided by the commercial sector. If possible, such training should be given in the country concerned. The hardware requirements of interfacing protocols will make the development of a standardized network training package for national node computer workers a desirable route. Such a package might be negotiated with major suppliers on a pattern analogous to that used by major microcomputer manufacturers in higher educational institutions in North America.

The major planning effort directed at training the global system *operators* must be accompanied by an equally important set of initiatives directed to provisions for training the *users* of the global network system. Again, this would follow the same pattern adduced above in discussing operator training (that is, advanced—basic—nonexistent). Users in advanced industrial nations would be expected to acquire system operation essentials on their own. Although there is extensive evidence from existing systems that this is not necessarily, or always, a straightforward procedure, the point to be made is that the additional educational effort in developed countries would not receive resource allocations from the network educational system. Developed countries would be required to develop additional educational systems, if needed, using their own resources. For those in countries with a basic competence in scientific and technical information services, or with previous educational or work experience in countries with a developed information environment, user education could take the form of "refresher" or "update" courses allied to an awareness of current local provisions. For those with no previous exposure to scientific and technical information services, the training will have to be at a more basic introductory level. The structures to be provided in this area should become a regular feature of the national system developed by all countries in the global network.

It is not anticipated that the United Nations itself will need to provide the training personnel in these latter two categories. This personnel should be provided by the host countries to ensure requisite sensitivity to local needs. The appropriate role for the United Nations will be to assist in training the trainers. The most effective form of such education is the provision of opportunities for these persons to give courses in their own countries. They will gain experience not only with the content to be presented but also in testing methods for delivering this content effectively. Again, the United Nations can play a considerable role in contracting out the training of the trainers (along the lines suggested for operator education above) to institutions such as the British Library Lending Division, which have expertise in this area.

In addition to contracting out user training, the United Nations could also contract out the preparation of appropriate training aids such as audio and video tapes, films, and computer packages for training in information searches. In many cases these materials may be available from established schools of library and information service, and need not be specially commissioned. In such cases, the United Nations could act as an information source for its own information network. Depending on local circumstances, the use of distance-learning technologies should be explored as a mechanism for delivering educational programmes for user training.

A final issue in user education is to ensure that such activity is focused effectively. This requires a needs study, to determine who can benefit from the introduction and development of scientific and technical information services. Supporting publicity should be provided to maximize the effectiveness of such a study. This will provide great benefits, not only in ensuring the receptivity of host nations to the global system operations, but also in convincing the developed countries, whose aid will be crucial in construction and maintenance of the system, that real needs are being met.

Conclusion

This paper has identified a set of issues for discussion that the authors believe are important to the establishment of a global scientific and technical information network. The purpose is twofold: to stimulate debate by describing appropriate problems, and to provide some thoughts on possible approaches for resolving them.

Throughout the discussion of issues, a common thread has emerged: that the benefits which proper construction of the system can achieve are extraordinary, if appropriate means and ends are clearly articulated at the outset. By taking the general benefits into account, the global network's developers can maximize the degree to which the new order they propose will benefit all the participants—overcoming resistance by champions of the old way of doing things, while kindling the imagination and drive of those who will benefit most from a global referral system.

PART THREE

National and Regional Experiences

Existing Conditions in Developing Countries for Science and Technology Information Activities

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In the first part of this paper, an attempt is made to present a broad view of the existing conditions in developing countries as regards scientific and technological information activities.

The approach chosen is the classification of the developing countries into three categories, according to their level of development as far as scientific and technological information is concerned. Then, for a set of issues considered of major relevance, it is attempted to point out what the average conditions in each category of countries are supposed to be.

Based on the overview in Table 1 of this report, Table 2 describes what the common problems regarding each issue are likely to be, and a list of suggested actions to meet the problems identified is presented.

The reader must keep in mind that no survey was done or consulted to justify the statements made; what is being presented is based on the author's experience and, mainly, on his assumptions. Therefore, the paper doesn't intend to be a precise analysis of the subject, nor does it reflect the views of author's organization or that of the United Nations Centre for Science and Technology for Development.

It has been prepared to serve as a starting point for the discussion by the specialists invited by UNCSTD to the Rome Panel, and only in this context must the ideas hereinafter presented be considered.

Table 1. General Characteristics of Existing Scientific and Technological Information Activities in the Developing Countries

Issues	Countries with a low level of science and technology information activities	Countries with a medium level of science and technology information activities	Countries with major science and technology information activities
1. Policies and Plans for S+T information activities	Absence of both national S+T development plans and plans for S+T information activities.	National S+T development plans may exist but policies and plans for S+T information activities are hard to find.	National S+T development plans do exist and policies and plans for S+T information activities are likely to be found.
2. Infrastructure 2.1 - Institutional organization	Very few organizations perform S+T information activities: universities; research organizations. There does not exist an organization with recognized authority and competence to perform the role of co-ordianting agency of national S+T information activities.	For some subject areas and industrial sectors one may find appropriate organizations to carry out S+T information activities at a national level: most of them are government and research organizations, or universities. Often they compete with one another for conducting and co-ordinating S+T information within the country. There does not exist, however, a single organization with clear competence and recotnized authority to play the role of co-ordinating agency.	Appropriate organizational arrangements are found for some subject areas and industrial sectors, which allow for strong S+T information activities in those areas/sectors. There exists a national co-ordinating agency for S+T activities; nevertheless, it does not have the strength needed to co-ordinate all ranges of information activities carried out within the country.

Table 1 (continued)

Table General Characteristics of Existing Scientific and Technological Information Activities in the Developing Countries

Issues	Countries with a low level of science and technology information activities	Countries with a medium level of science and technology information activities	Countries with major science and technology information activities
2.2 - Information Sources 2.2.1 Periodicals	Almost no complete collection of even a small number of relevant titles is likely to be found within the country. The fragmentary and poor collections may exist. A national union list of periodicals does not exist. There is no systematic mechanism for document delivery.	Only a few titles most relevant for S+T are available in complete collections. Most collections of S+T journals are fragmentary. Few successful attempts for establishing and maintaining a National Union List of Periodicals. Document delivery systems may be found for some subject areas/sectors. Great dependence on foreign document delivery systems.	The most relevant collections in S+T are maintained by certain major organizations. The majority of the existing organizations, however, do not subscribe to the journals they need for their regular activities. Some countries have succeeded in maintaining a national union list of periodicals and document delivery systems. The majority of the collections are fragmentary.
2.2.2 Books, monographs	The collections are extremely poor in almost all fields. Most collections are out-of-date. Generally, only university libraries hold book collections on S+T fields.	The collections are poor. The main collections are held by university libraries and by the few existing research centres. Almost every organization has serious difficulties in acquiring new titles.	The collections are poor in the majority of the subject fields. Collections are held by university libraries, research centres, and information and documentation centres and networks.
2.2.3 Patents	Almost unknown as a source of relevant technological information.	Some countries may have good collections of patent documents, but there is no efficient mechanism for making them available to final users.	Some countries may have strong stocks of patent documents, but the access mechanisms, if they exist, are weak.

Table 1 (continued)

Issues	Countries with a low level of science and technology information activities	Countries with a medium level of science and technology information activities	Countries with major science and technology information activities
2.2.4 Technical Standards	Almost unknown as a source of relevant technological information.	Only a very small number of complete collections from major standard organizations may be found within the country. There is no efficient systematic mechanism for accessing/acquiring technical standards.	Complete collections from major standard organizations may be found in several organizations. Documents on the mechanisms for accessing/acquiring technical standards are inefficient.
2.2.5 Technical reports. Grey literature	No systematic mechanism for collecting, processing, storing and making technical reports and grey literature available to local users.	No systematic mechanism for collecting, processing, storing and making technical reports and grey literature available to local users.	Existing mechanisms for collecting, processing, storing and making technical reports and grey literature available to local users are weak and inefficient. These materials do not receive great attention from the existing information services.
2.2.6 Factual	No systematic mechanism for collecting, processing, storing and making factual data relevant to S+T activities available to local users.	Very few systems exist and, when they do, they are implemented and operated by government agencies; they are mostly related to statistics on social, economic and commercial subjects. Access to the existing systems for scientists and engineers is difficult. Data is not always trustworthy.	Information systems providing data relevant to S+T activities are being implemented at a reasonable rate. Some countries already have information systems on current researchers, research and development organizations and infrastructure, researchers markets, export/import data, and the like. Coverage may not be full in terms of subject fields/sectors or geographical areas. Conventional statistical data are easily accessible. Seldom can searchers be performed on-line.

Table General Characteristics of Existing Scientific and Technological Information Activities in the Developing Countries

Table 1 (continued)

Table General Characteristics of Existing Scientific and Technological Information Activities in the Developing Countries

Issues	Countries with a low level of science and technology information activities	Countries with a medium level of science and technology information activities	Countries with major science and technology information activities
2.2.7 Secondary Publications Sources	Some major collections of abstracts may be found in some organizations.	Some major collections of abstracts are found in several organizations. Access to data bases is feasible through telecommunications, although costs prevent wide use. Data bases are not processed internally in the country.	Almost any published abstract can be found in at least one of the national organizations, university libraries, research and development information centres, and other documentation centres keep collections of the abstracts most relevant to their activities. Access to foreign data bases may be provided through several points. Cost prevent wider use. Most frequently used data bases have been acquired for internal processing.
2.3 - Personnel	Deficient, both in quantity and quality.	Deficient, both in quantity and in quality. Excentions may be found for some specific tasks. Lack of experience in joining multidisciplinary teams for performing S+T information activities.	Deficient, mainly in quality. Some very skilled individuals can be found. Weak experience in multidisciplinary work in the area of S+T information.
2.4 - Education and training	Poor or non-existent educational and training programmes for training people for S+T information activities. There is no graduate programme relevant to the field.	Poor educational and training programmes on a regular basis. There is no graduate programme relevant to the field. The existing provision of education/training in the area of S+T information emphasizes scientific information rather than technological information.	The offer of educational and training programmes may have reached a satisfactory level in quantity but their quality should be greatly improved. Some educational programmes, at the graduate level, may exist: librarianship, information sciences, computer sciences, linguistics, etc. Training programmes for people in the area of technological information are less frequent.

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Table 1 (continued)

Issues	Countries with a low level of science and technology information activities	Countries with a medium level of science and technology information activities	Countries with major science and technology information activities
2.5 - Computer Facilities	Almost non-existent for S+T information applications.	No computer facilities entirely dedicated to S+T information uses. Initial efforts can be found in the use of automation of information activities through existing computer facilities of the organizations to which the information systems are related. Seldom do the computer facilities of the parent organization allow for on-line searches of data bases.	Some information systems operate on an entirely automated basis. Spread of the use of micro/mini computers that permit on-line access of data bases. Only in very few cases does one find large-capacity computer facilities entirely dedicated to S+T information purposes. Restrictions are being imposed by some countries for importing computers and peripherals.
2.6 - Telecommunications	Availability is poor enough to prevent, at present, any larger effort to improve dissemination of information and to allow efficient co-operative programmes in the area of S+T.	Available communication channels may permit use of remotely located terminals to access external information systems, at least from the major cities. The level of telecommunications, however, does not permit interlinking distantly located information systems within the country so as to make feasible the operation of local information networks.	Some countries already possess the newest telecommunication facilities (satellite, "pack-switching data transmission", etc.). Costs of telecommunications, however, remain too high to allow massive use for S+T information purposes.
2.7 - Software	Non-existence of local capability to develop/adapt software for information handling.	Non-existence of local capability to develop software for information handling, in the majority of cases. Available software is acquired from foreign sources.	Some existing information systems use locally developed software or have adapted software from foreign sources. Software-houses, in the private sector, are being set up in some countries. Restrictions against importing softwares are being imposed by some countries.

Table 1 (continued)

Issues	Countries with a low level of science and technology information activities	Countries with a medium level of science and technology information activities	Countries with major science and technology information activities
2.8 - Equipment (typewriters, word processors, microform readers/copiers)	Deficient in quality (old models) and in quantity.	Deficient in quality (old models) and in quantity.	Most organizations do not have the needed equipment and only major institutions have the appropriate machinery.
2.9 - General tools	Complete absence of indexing language, thesauri, methodologies, etc., for S+T applications in local languages. Absolute lack of capability and resources for developing these on their own.	Scarcity of indexing languages, thesauri, methodologies, etc., for S+T applications in local languages or appropriate for local conditions. Lack of capability and resources for developing these on their own.	Poverty of indexing languages, thesauri, methodologies, etc., for S+T applications in local languages or appropriate for local conditions. Limited capability and resources for developing them locally.
3 - Information environment and user behaviour 3.1 Information environment	Social and cultural values constitute strong barriers against the flourishing of S+T information activities. Societies may have priorities other than S+T activities.	Social and cultural values do not favour S+T information activities. Reading is not a strong habit of the average citizen. Number of scientists and researchers is very low. Since the demand is low, there is little pressure for improving S+T information activities.	Social and cultural values do not favour S+T information activities. Reading is not a strong habit of the average citizen. Number of scientists and researchers is low.
3.2 Users' studies	Nonexistent.	Nonexistent, or else available on a non-systematic basis for some specific subject areas and/or carried out within given geographical or institutional limits.	Increasing concern about users' studies, which actually have been carried out for some subject areas or industrial sectors already. No regular mechanism for monitoring the evolution of users' needs. Use of different methodologies for the studies already done.

Table General Characteristics of Existing Scientific and Technological Information Activities in the Developing Countries

Table 1 (continued)

Table General Characteristics of Existing Scientific and Technological Information Activities in the Developing Countries

Issues	Countries with a low level of science and technology information activities	Countries with a medium level of science and technology information activities	Countries with major science and technology information activities
3.3 - Users' education	No mechanism for forming a favourable attitude towards S+T information use.	Potential users are not approached on a systematic and appropriate basis so as to make them more sensitive to the offer of S+T information or more conscious of the need/value of S+T information.	Potential users are not approached on a systematic and appropriate basis so as to make them more sensitive to the offer of S+T information.
4. Services/ products	Very limited. The majority of available services are the basic, primary ones provided by libraries which, in turn, have very poor collections.	Services are limited to some few areas/ sectors, which have evolved from university libraries and documentation centres of research organizations. Their scope is limited (few different kinds of information services). Users from different geographical areas do not have equal access to existing services. Services are more scientifically oriented (to the needs of scientists) than technologically oriented.	Many subject areas/disciplines or industrial sectors remain without well-structured information services. Some existing information services provide a wide range of services, including selection dissemination of information and on-line access to several data bases. Services to users from the industrial sectors tend to be less frequent and/or efficient the ones directed to scientists. The stronger services are usually the ones connected to international information services and networks, supported by international agencies.

Table 1 (continued)

Table General Characteristics of Existing Scientific and Technological Information Activities in the Developing Countries

Issues	Countries with a low level of science and technology information activities	Countries with a medium level of science and technology information activities	Countries with major science and technology information activities
5. Referral services (information about information. Secondary publications are excluded).	Almost nonexistent. Existing libraries may provide poor referral services, on a non-systematic basis.	Poor. The existing referral services are specialized by subject areas and do not cover all the range of S+T information. Some attempts have been made to develop directories of national sources (research organizations and universities, researchers, engineering/consultancy firms, etc.).	Limited, although the existing well-structured information systems provide regular referral services. A clear trend can be noticed toward developing referral services related to local resources (information services, research organizations, current researches, researchers). Some countries already have developed referral data bases that can be searched on-line.
6. National information networks	Nonexistent	There exist a few sectoral or specialized information networks, with limited coverage. The stronger ones are connected with networks supported by international agencies. The co-operative links among local organizations, however, are very weak and they are mainly centred in a node that actually carries out almost all functions/services of the networks.	There exist a few sectoral or specialized information networks, with limited coverare. The stronger ones are connected with networks supported by international agencies. The co-operative links among local oreaniza-tions, however, are very weak and they are mainly centred in a node that actually carries out almost all functions/services of the network.

Table 1 (continued)

Issues	Countries with a low level of science and technology information activities	Countries with a medium level of science and technology information activities	Countries with major science and technology information activities
7. Regional, subregional or international networks	Nonexistent, as a general rule. When the country participates in such networks, the actual results are irrelevant because it has neither the prerequisites to add its information into the network nor the internal channels to make the network information available to national users.	The actual benefits from participating in such networks are limited because of the internal difficulties in adding locally generated information into the networks; and, on the other hand, in disseminating within the country the information available from those networks. Exceptions are the cases where the country does have a fairly structured information system on the subject area covered by the network. Often the exchange of information through such networks becomes limited to exchanging information among government organizations of the participating countries, not reaching the final users from universities, research and development organizations, and private enterprises.	Many formal agreements for exchanging information and participation in regional, subregional, and international organizations have been signed. In many cases, the countries do not have the prerequisites (infrastructure, resources) to allow for an efficient participation in the network; thus most networks seldom reach their goals. Experience shows that the most successful networks are those that correspond to existing internal information systems and networks, so that the external networks add information/resources to internal information systems that are already operating.
8. International co-operation (bilateral and multilateral) 8.1 - Among developing countries	Nonexistent, because of the lack of mechanisms and experience of exchanging information and sharing resources among them.	Agreements of co-operation seldom yield expected results because of the weakness of available mechanisms and existing experience..	Eventually, co-operation among particular countries is successful. As a general rule, however, the available mechanisms for co-operation in the field of S+T information are weak and their results are unsatisfactory. Very seldom are consultants from developing countries invited to other developing countries.

Table General Characteristics of Existing Scientific and Technological Information Activities in the Developing Countries

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Table 1 (continued)

Table General Characteristics of Existing Scientific and Technological Information Activities in the Developing Countries

Issues	Countries with a low level of science and technology information activities	Countries with a medium level of science and technology information activities	Countries with major science and technology information activities
8.2 - With developed countries	Some attempts have been made by international agencies to provide financial and technical assistance through consultancies from developed countries and training programmes in them.	Consultancies from developed countries and training abroad are frequent, mainly sponsored by international organizations or the developed countries themselves. Some projects in the area of S+T information have been funded by international organizations or by developed countries directly.	Consultancies from developed countries and training abroad may be very frequent, mainly sponsored by international agencies or by the developed countries themselves. Some countries are already effectively exchanging locally generated information with developed countries.

Table 2. Action to solve some common problems in each of the major issues related to science and technology information now existing in the developing countries.

- Suggestions of concrete actions that could help to overcome these problems -

Issues	Common Problems	Some possible concrete actions
1. Policies and plans for S+T information activities	Absence of S+T information plans and policies and limited internal (local) capability to develop them.	1. Identify eventually existing national S+T information plans and policies in the developing countries. 2. Support the development of national S+T information plans and policies for a few countries, so as to have at least one document (plan) for each one of the three classes of countries. 3. Write detailed methodologies clarifying how (1) and (2) have been developed. 4. Translate (1), (2) and (3) into major languages for the developing countries (English, Spanish, French) and provide full dissemination to the developing countries. 5. Develop political actions aiming at sensitizing national governments to develop S+T information plans and policies. 6. Provide technical and financial support for the countries that decide to develop their S+T information plans and policies.
2. Infrastructure 2.1 - Institutional organizational	Lack of an institutional organization (structure) appropriate for co-ordination and execution of S+T information activities.	1. Describe alternative models of institutional infrastructure in some developing countries that have been more successful in carrying out S+T information activities. Make clear what roles and responsibilities the organizations in each country have, as far as S+T information is concerned, and the links and relationships among such organizations. 2. Translate and disseminate documents (1) as indicated for issue 1, action 4.

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Table 2 (continued)

Issues	Common Problems	Some possible concrete actions
		3. Develop political actions aiming at sensitizing national governments in order to establish institutional infrastructure that favours the development of S+T information activities. 4. Provide technical assistance to the local governments that decide to design and implement new organizational arrangements appropriate for S+T information activities.
2.2 Information sources 2.2.1 Periodicals	Countries do not have collections of the most relevant titles. Furthermore, the existing collections are not made available to all local users.	1. Develop studies to identify the "core" collections of titles in the subject fields relevant to the developing countries. 2. Write methodologies on how to implement and operate National Union Catalogue of Periodicals' systems based on the experience of developing countries that have already developed theirs. 3. Describe experience of developing countries related to document delivery systems that they may have developed internally. 4. Translate studies (1) and methodologies (2) and (3) into the major language and provide the dissemination as indicated for issue 1, action 4. 5. Stimulate the translation of (1) into local languages of the developing countries, in order to make them broadly accessible to actual practitioners within each country. 6. Provide financial and technical support for executing pilot projects in at least one country of each of the classes of countries, aiming at a co-operative plan for acquisition of periodicals (groups of organizations share the responsibilities for each organization's subscribing to a set of periodicals and making them available to all the others). Write detailed ...../

Table 2 (continued)

Issues	Common Problems	Some possible concrete actions
		methodologies of the resulting systems when they prove operational. Translate and disseminate as indicated for issue 1, action 4.
2.2.2 Books, monographs	The collections are poor and out-of-date.	1. Identify and evaluate experience of developing countries related to the design and operation of National Union Catalogue of Books system and to the implementation of plans for co-operative acquisition of books/monographs. 2. Elaborate methodologies corresponding to the experience (1) that have proved to be worthwhile. Translate and disseminate as indicated in issue 1, action 4.
2.2.3 Patents	The collections are poor and the use of patent documents as sources of information is meagre.	1. Fully disseminate among developing countries information on how the international system of industrial property operates, what the role of WIPO is, etc. 2. Stimulate countries to make international agreements for the exchange of patent documents so as to contribute to the growth of local collections of patent documents. 3. Identify successful experiences of developing countries in providing patent information to local users, and make those experiences known to all developing countries through publication and dissemination of documents specifically designed for that purpose. 4. Stimulate developed/developing countries to offer "on-the-job" training on patent information of professionals from the developing countries. 5. Disseminate information on international sources of patent information.

Table 2 (continued)

Issues	Common Problems	Some possible concrete actions
2.2.4 Technical standards	The collections are poor and the use of technical standards as sources of information is meagre.	1. Stimulate countries to join ISONET network and, in some cases, provide technical and financial support for developing countries to improve their local conditions so as to meet the requirements for joining ISONET. 2. Identify successful experiences of developing countries in providing technical standards information to local users and make those experiences known the way suggested in issue 2.2.3, action 3. 3. Stimulate developed/developing countries to offer "on-the-job" training on standard information to professionals from the developing countries.
2.2.5 Technical reports, Grey literature	No systematic procedures for gathering, processing, storing and retrieving technical reports and similar materials.	1. Exchange experiences among developed and developing countries, and/or among developing countries themselves, focusing on the possible alternative models for dealing with those documents: (i) sectoral/specialized by subject arrangements; (ii) regional arrangements; (iii) others. The channels could be: (a) publication of specifically designed descriptive documents or methodologies; (b) technical meetings; (c) consultancies; (d) "on-the-job" training programs.
2.2.6 Factual data	Poor systematic procedures for gathering, processing, storing and retrieving factual data.	1. Exchange experience approximately in the way described in issue 2.2.5, action 1. 2. Identify existing strong and successful factual data information systems in the developing countries. Note their methodologies. Translate and disseminate these as indicated in issue 1, action 4. 3. Provide technical and financial support for the development of software for implementing factual data banks relevant to science and technology that could be transferable to the developing countries.

Table 2 (continued)

Issues	Common Problems	Some possible concrete actions
2.3 Personnel	Limited number of experienced professionals for both operational and managerial functions.	1. Stimulate professionals with different backgrounds to join information centres, services, and networks, in order to strengthen multidisciplinary teams. 2. Prepare, publish and disseminate a directory of information specialists from the developing countries, which should give a precise description of their actual expertise, so as to facilitate co-operation through consultancy missions from one developing country to another and increase the participation of national consultants in local activities. 3. Massive training programmes, as indicated in issue 2.4, next.
2.4 Education and training	Existing initiatives are limited and the quality of the programmes is poor.	1. Provide technical support through consultancy missions from developed/developing countries to participate in discussions and planning aiming at improving curricula and related academic activities of formal educational programmes existing in developing countries in the area of S+T information (undergraduate and graduate levels). 2. Provide scholarship for nationals from developing countries to get higher education (master and doctoral levels) in developed and developing countries. 3. Stimulate and give support for the design and implementation of graduate programmes in certain developing countries. Those specifically designed educational programmes should be strongly oriented to the needs and realities of developing countries. They must operate on a regional level, and therefore should be established in countries and be taught in languages most convenient to the majority of the developing countries. 4 Provide technical and financial support for the improvement of existing formal educational programmes in the developing countries, through specifically funded projects: visiting professors, strengthening of library collections on information, providing equipment, etc. ...../

Table 2 (continued)

Issues	Common Problems	Some possible concrete actions
		5. Enlarge the opportunities for "on-the-job" training of professionals from developing countries in information centres and services existing in developed/developing countries. Design specific training programmes to meet the needs of developing countries.
2.5 Computer facilities	Non-existent or insufficient for S+T information uses.	1. Identify relevant experiences of developing countries related to the use of micro/mini computers for information activities. Provide full technical description of the computer installations and of the services performed, through documents issued in languages most accessible to developing countries, so as to make available models that can be used in improving local computer facilities. 2. Provide financial support for the improvement of computer facilities specifically devoted to S+T information activities in the developing countries, through projects sponsored by developed countries and/or international organizations.
2.6 Telecommunications	Non-existent, poor, or too expensive for wide use of S+T information activities.	1. Stimulate the inclusion in national plans, informatics and telecommunications development, among the priorities drawn from S+T information plans. 2. Diffuse information about cases in which countries (developed and developing) have succeeded in integrating telecommunications and S+T information plans and policies.
2.7 Software	Limited capability for the development/adaptation of software designed for S+T information uses.	1. Prepare, publish, and disseminate a directory of available pieces of software in developing countries for S+T information handling, emphasizing those locally developed.

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Table 2 (continued)

Issues	Common Problems	Some possible concrete actions
		2. Stimulate countries to include in their bilateral and multilateral co-operation programmes the exchange of software for S+T information uses. 3. Provide financial support for the development of multi-purpose software likely to be transferrable to all interested countries. These pieces of software should be designed according to the average existing computer facilities in the developing countries, and priority should be given to software for mini and microcomputers for S+T information uses.
2.8 Equipment	Deficiency in quantity and quality.	1. Provide financial support for the improvement of infrastructure through the development of funded projects in S+T information activities.
2.9 General Tools	Non-existence of appropriate tools (methodologies, thesauri, patterns, standards, etc.)	1. Provide technical and financial support for the development of multinational projects by countries with common languages, aiming at translating or adapting or creating thesauri in the subject fields most relevant to their needs. 2. Develop methodologies for basic services/studies in the field of S+T information, such as: (i) user surveys; (ii) evaluation of existing collection; (iii) definition of core collection of periodicals in different fields; (iv) treatment of special bibliographic materials; (v) provision of special services; (vi) other methodologies pointed out in other parts of this document 3. Translate and disseminate (2) as indicated in issue 1, action 4. 4. Stimulate the translation of methodologies (2) into local languages so as to facilitate the broad use of them by practitioners within the countries.

Table 2 (continued)

Issues	Common Problems	Some possible concrete actions
3. Information Environment and users' behaviour		
3.1 Information Environment	Social and cultural values do not favour the flourishing of S+T information activities.	1. Sensitize local governments in order to develop and implement educational programmes, on a systematic basis, aiming at improving the population's level of interest in books, journals, newspapers, etc. 2. Stimulate appropriate international agencies to increase their level of support of activities to increase the use of information by the population of developing countries. 3. Support programmes for creating/improving the existing mechanisms for bringing information on the relevance and achievements of the scientific activities to the whole population (science journalism).
3.2 Users' studies	Users' demands and behaviour are not known.	1. Identify possible existing users of studies carried out in developing countries at either a sectoral, specialized, or regional/institutional levels. Select those most appropriate to serve as models for similar studies in other developing countries. Write down the methodologies. 2. Translate and disseminate (1) as indicated in issue 1, action 4. 3. Stimulate translation of (1) into local languages. 4. Provide technical and financial support to carry out users' studies in the developing countries, for those fields most relevant for local development. 5. Pay equal attention to studying the demands and behaviour of users from both the scientific and the technological areas. 6. Stimulate the exchange of existing users' studies among developing countries.

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Table 2 (continued)

Issues	Common Problems	Some possible concrete actions
		7. Strengthen the premise that users' studies are essential to the planning of any S+T information activity. This should be reflected in project proposals for external support to be presented in the future by the developing countries
3.3 Users' education (S+T information)	Non-existence (or weakness) of mechanisms for diffusing the availability of S+T information.	1. Provide technical and financial support for the development of pilot experiences related to the marketing and diffusion of existing information services in the developing countries. 2. Evaluate experiences and write down methodologies corresponding to the successful ones. Translate them into major languages in the developing countries. Provide full dissemination of these methodologies to the developing countries. 3. Stimulate local information systems to implement strong mechanisms for diffusing their services to potential users on a systematic basis. 4. Stimulate local and international organizations to include in the programmes of technical meetings which they sponsor in developing countries, a special section devoted to the diffusion of local and foreign/international information products and services relevant to the particular subject of the technical meeting.
4. Services/ products	Insufficient both in availability and in quality.	1. Develop methodologies for the implementation of information services and for the publication of information soruces/tools (bulletins, newsletters, guides, etc.) 2. Translate and disseminate (1) as indicated in issue 1, action 4. 3. Stimulate the translation of methodologies (1) into local languages for broad dissemination to practitioners in each country.

Table 2 (continued)

Issues	Common Problems	Some possible concrete actions
		4. Strengthen the mechanisms for exchanging information products (bulletins, newsletters, guides, etc.) among developing countries with common languages. 5. Share experiences for designing and operating special services such as (i) technological extension; (ii) services based upon data bases (selective dissemination of information) retrospective search, on-line access; (iii) information analyses; (iv) question-answering services; etc. The mechanisms could be similar to those indicated in issue 2.2.5 - action 1.
5. Referral services	Not available on a regular basis for the great majority of subject areas.	1. Identify possible existing experiences in setting up referral services in the developing countries. Evaluate these experiences. Write correspondent methodologies (automated referral services; guides to information; directories; current researches, researchers, consultants, engineering firms, information and documentation centres). 2. Translate and disseminate (1) as indicated in issue 1, action 4. 3. Provide technical consultancy from the developed/developing countries to the developing countries willing to implement national referral information systems. 4. Strengthen the mechanisms for exchanging referral information among countries with common languages and/or countries in the same region. 5. Develop efforts towards implementing a global referral information system.
6. National information networks	Non-existent, very weak, or quite informal.	1. Strengthen existing initiatives through technical and financial support. Provide international co-operation from the developed to the developing countries.

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Table 2 (continued)

Issues	Common Problems	Some possible concrete actions
		2. Stimulate the creation of sectoral, specialized, and geographically limited, multi-disciplinary S+T information networks. 3. Exchange experiences among developed/developing countries related to the design and operation of sectoral/specialized national information networks through several mechanisms: (i) exchange of conceptual documents and operational manuals; (ii) meetings; (iii) "on-the-job" training programmes; (iv) consultancy missions, etc. 4. Support the development of studies about alternative models for setting up national information networks: (i) possible network typologies; (ii) information gathering and treatment: (iii) access for final users; (iv) communication media; (v) management issues, etc. Those studies should be developed taking into consideration the actual existing conditions and assigned priorities of the developing countries. 5. Translate and disseminate (4) as indicated in issue 1, action 4.
7. Regional, subregional and international information networks	Non-existent or very weak.	1. Approach similar to issue 6 above.
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Table 2 (continued)

Issues	Common Problems	Some possible concrete actions
8. International co-operation (bilateral and multi-lateral) 8.1 Among developing countries	Non-existent or very weak.	1. Identify cases where co-operation among developing countries has been successful. Make those experiences known through detailed reports, methodologies, meetings, conference presentations, etc. 2. Eliminate prejudices that prevent consultants from a developing country from giving technical assistance to other developing countries. Instead, this kind of co-operation should be stimulated/supported by international organizations.
8.2 With developed countries	Efficiency should be improved.	1. Establish a kind of "clearing-house" in each developing country for keeping all consultants' reports about S+T information issues in those countries. Create mechanisms for making these reports available to : (i) any new consultant that comes in; (ii) selected national users: (iii) other countries. 2. Prepare detailed and clear general orientations for the developing countries on how to develop the prenaratory phase for receiving external consultancies: (i) identify and collect existing documents that might be relevant to each particular mission; (ii) assign a national counterpart· (iii) schedule visits to local organizations and related arrangements: (iv) schedule meetings with nationals; (v) list recipients of the final report: etc. The objective is to make the consultants' work more efficient. 3. Whenever possibel, consultants should be chosen who can speak the languages of the country they are going to serve. Also, preference should be given to those consultants who have had working experience in developing countries, because of their better knowledge of local realities. 4. Co-operate with the developing countries in several ways, as indicated in many of the issues described above.

Information Systems for Science and Technology for Development: Some Egyptian Observations

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Scientific and technological information, like other information services, or commodities, responds to social needs. It is true that scientific and technological information paves the way to the creation and modification of social demands, but it does so only insofar as these demands reflect an overt or potential need.

The major burden on developing countries is the complex social, cultural, economic, managerial, and political changes that need to be introduced to create the social need for scientific and technological information.

The underlying need may be there all the time, but it is not socially recognized, uninformed decisions on policies, programmes, projects in science and technology will prevail, even though their feasibility and efficiency repeatedly prove lacking. The spontaneous evolutionary development of a social need for scientific and technological information is a protracted and unreliable process in developing countries, handicapped as they are with rapidly moving frontiers, conflicting urgent priorities, and limited resources. Egyptian experience in national policies in this field and their motives may be instructive.

The nationalization of the Suez Canal in the 1950s was the culmination of a new political will and orientation. The resulting economic blockade and tripartite invasion (France, United Kingdom, Israel) underlined many previously unrecognized social needs, among them a need for scientific and technological information. Egypt, of course, had had a substantial scientific and technological infrastructure for years. However, the recognition of the social need for its product was limited to certain dominant sectors, such as agriculture, irrigation, and medicine. The spread of this recognition, in the late 1950s to other fields was energetic and sometimes precipitate. Fields like the drug and military industries achieved significant relative progress in managing and utilizing science and technology information in a few years. Institution building was also achieved and a degree of integration in policy formulation and planning was realized. It was remarkable to observe the impact of a nationally recognized social need on the commitment and efficiency of partially trained personnel.

The euphoria of this phase culminated with the design and implementation of the first five-year development plan in the early 1960s. In spite of some serious defects and mistakes in design, implementation, and management, it fueled widespread, though uneven, institution building and programming in the field of scientific and technological information. As with all nationally planned and precipitate major shifts, the relevance and efficiency of the different sectoral programmes varied widely, with many irrelevant developments draining resources. But it was during this experience that the social need was recognised once and for all, with its consequences: the demand for nationalization of education and training programmes, the frustrating experiments in promoting research and development and integrating it with development and policy formulation, and the addition of a scientific and technological information dimension to the complexities of decision making.

After the 1967 war with Israel and the ensuing economic and political crises, many priorities shifted. Security needs became paramount. On the development front, continuity became more and more difficult; and because of a "fire extinguishing" strategy many ongoing plans were arrested or dissipated.

Discontinuity affected some of the bases under construction in the field of scientific and technological information, coupled with increasing alienation of the science and technology community from the process of developing and policy formulation.

By the late 1970s, the accumulating bottlenecks, the mounting deficiencies and shortages, and the crumbling of services, coupled with a mushrooming global crisis, emphasized the urgent need for resumption of the development of science and technology infrastructure.

In the scientific field the established policy of universal education coupled with the problems of the multiplying crowded, under-financed universities, affected the quality of training. On the other hand, the "brain export" (the departure of almost four million scientists, engineers, teachers, and skilled labourers) is still being angrily debated, the question being whether the loss of their information and skills is really compensated for by the amelioration of the nation's unemployment and by the urgently needed rebates of valuable hard currency. Some sectors in services and production have suffered more acutely than others from shortages. Although science and technology information services and networks have been upgraded, the persistent acute shortage of foreign currency affects the continuity of this process and gaps are the rule. The supporting services are the first to suffer from foreign currency shortages, and thus their services are denied to any but the most dedicated academicians. Duplication and lack of co-ordination drain further resources.

Increasingly projects in international co-operation are being established in the field of scientific and technological information. The cost-efficiency ratio is not always satisfactory and the priorities and orientation are naturally questioned by some, although others find them a godsend. The time and labour expended in their use by outsiders, however, limit the scope of their utility. Most are academically oriented services (universities and research institutes); some are service-oriented, such as those dealing with the census and with health. Their efficiency and effectiveness varies widely; some are of high standard.

Linkages with international science and technology services are carried out either through the traditional foreign culture centres and libraries, some of them popular in their field, or through foreign institutes or in projects shared with international organizations, many of which are highly regarded by their Egyptian partners.

Some service sectors and production sectors have their own information services, particularly agriculture, petroleum, drug manufacture, and waterways. Linkages with universities and institutes supplement and extend these services; and a large potential is recognized for progress in this co-ordinative and integrative function.

At the national level, a nucleus was established in 1956 (renamed in 1962): the National Centre for Information and Documentation, a component of the Academy of Scientific Research and Technology. In addition to maintaining a reasonable library, the centre has an information service, as well as systematic linkage with international networks. This service is available to all workers for a reasonable fee.

The centre is starting the publication of selective bibliographies and also publishes periodicals and proceedings for scientific organizations, as well as conducting a conference service. Its resources, however, are far from adequate for its functions and thus the Centre can cover the needs of only a small fraction of its potential users.

Scientific societies play a very important role in disseminating information. In 1982 there were 71 national societies in the scientific field. Some are very active, having their own periodicals, conferences, and symposia, as well as enjoying active international co-operation. The professional societies in medicine and engineering are the ones best positioned to finance their activities and publications. State support is very limited in both scope and volume. These societies have the largest audiences; they establish co-operative relations across sector boundaries and their international linkages are cosmopolitan and continuous. Perhaps, as regards cost effectiveness, they are among the country's best investment.

Most activities in these societies are scientifically oriented, and so is the information disseminated through them. This is a natural response to an existing social need to increase the number of scientific graduates and specialists. On the other hand, technology information is not yet uniformly recognized as a social need. The private sector in industry is totally dependent on licence agreements and package transfers of technology. The joint-venture industries (foreign-Egyptian) are completely dependent on the research and development of parent multinationals. The public sector which represents the dominant sector in industry is in no better position, with some notable exceptions, in the utilization of technological information.

In the current Five-Year Plan (1981-1985), the expected graduates number as follows:

Universities and higher institutes	456,371
Intermediate and other institutes	1,101,382

An inquiry carried out by the Central Organization for Census and Mobilization regarding the organization of the public sector (including the major industries) indicates that in 1976, of the institutions studied:

58.2 per cent had an information system
27.1 per cent did not have an information system
14.7 per cent did not know.

However, the study indicated that those who claimed to have a system had no more than non-integrated units for data collecting and processing as needed.

Most significant, however, was the nature of these units, judging by the answers received. Information systems were the responsibility of the following:

Economic department	38.3 per cent
Planning department	36.3 per cent
Accounting department	12.4 per cent
Board chairman's office	8.5 per cent
Others	4.4 per cent

Research and Development units were not mentioned in the answers.

The present and future needs of rapidly developing countries, with a mountain of urgent demands and with limited resources, necessitates a long-term plan. This is clearly more feasible in countries where capabilities and infrastructures are not scarce.

In Egypt two major undertakings are very much involved with the future of scientific and technological services, as follows:

National Science and Technology Policy

This project, started in 1981, has completed its first phase. The Academy of Scientific Research and Technology, regarding hundreds of experts from all sectors, has forwarded a proposed comprehensive policy for technology development to the national cabinet.

The project envisages a high priority for efficient systems of scientific and technology information, integrally linked to well-identified targets and functions promoting the utilization of information.

National Information for Egyptian Development (NIED)

This is one of the projects of the Academy of Scientific Research and Technology, and is completing its fourth year of implementation. (See the annex to this report).

Annex

NIED: How

NIED's Overall Structure

NIED comprises two autonomous components serving Egypt's problem-solvers:

Information services

Information services are specialized nodes in the national information system intended to couple users to information sources.

The services nodes will use mini-computers or super-micros to handle their basic informational functions.

Given suitable telecommunications, the nodes will be interconnected to form an open-ended, undirected network, allowing eligible users to communicate directly with any information service and document repository.

Through NIED distributed ring network, an authorized user can access any of its service nodes and repositories to get an answer for his query or copies of the original documents. Initial major functions of the service node:

— Development and maintenance of data bases of technical and logistic information produced in Egypt;

Searching of data bases located in Egypt and abroad (the latter through access to a public packet-switching network such as TELENET or TYMNET);

— Mediation of requests for document delivery from Egyptian and foreign repositories;

— Production and distribution of specific products emanating from the contents of such data bases;

— Referral services for information requests and needs that cannot be met through one of the above services; and

— Building up the user clientele in the sphere of activity of each service.

NIED over the next three years will establish fully operational model information services in five sectors that constitute priority areas for Egypt's socioeconomic development.

Document repositories

The proposed document repository, subsector of NIED, consists of a small number of selected Egyptian libraries whose collections contain a high proportion of primary NIED sources and which consent to make those collections available to NIED's users.

A carefully designed central acquisition program is incorporated within NIED to enlarge the unified collection of the participating repositories adopting the Resource Sharing Principle as its cost-saving mechanism.

NIED: What

Sources of Information

NIED's design is oriented towards problem-solving. Therefore, it has to be flexible enough to respond dynamically to the ever-changing needs of its different user categories.

NIED will handle a diversified range of information sources. These include:

— Books and monographs.
— Scientific and technical journals.
— Trade magazines.
— Dissertations and theses.
— Directories.
— Product catalogs and announcements.
— Patents.
— Government documents.
— Technical reports: Feasibility studies; investigation and auditing reports; technical proposals; etc.
— Bibliographies.
— Abstracts and indexing journals.
— Bibliographic data bases.
— Referral data bases (numeric and textual).
— Training manuals and aids.

Subject areas

The following table shows a sample of the subjects which NIED may cover in selected sectoral information nodes.

Sector	*Subject Areas*
Agriculture	Cotton
	Wheat
	Rice
	Sugar Cane
	Fisheries
	Livestock
	Land Reclamation
Energy	Petroleum
	Electricity
	Natural Gas
Industry and Natural Resources	Textile Industries
	Food Industries
	Engineering Industries
	Chemical Industries
	Metallurgical Industries
Medicine and Health Care	Medicine
	Pharmacology
	Veterinary Medicine
	Public Health
Science and Engineering	National Sciences
	Engineering
	Behavioral Sciences
	Social Sciences

NIED: For Whom

Priority Clientele

Whereas traditional STI systems tend to serve predominantly users who, by profession, are scientists or engineers, the intent of NIED is to serve directly or indirectly, the following categories of problem-solvers:

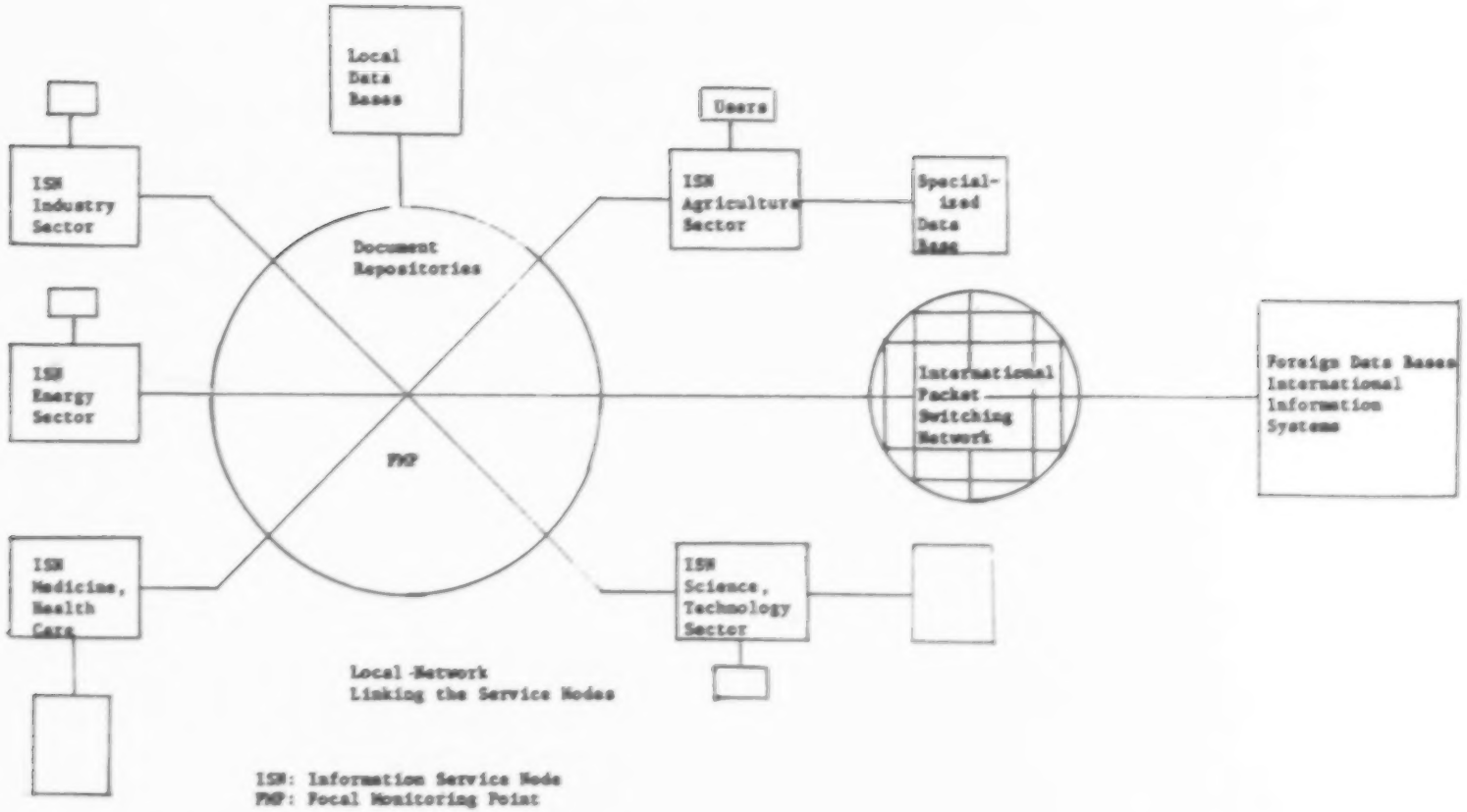
— Managers: policy-makers, businessmen and government decision-makers.
— Professional practitioners: engineers, physicians, planners, educators, farmers, etc.
— Applied researchers: natural and social scientists.

Services

NIED will initially provide the following information services:

— Data base development (numeric, bibliographic and referral data bases);
— Bibliographic search of local and foreign data bases via direct online, delayed online or batch searchers;
— Referral service to guide the inquirer to the source or sources most likely to provide the desired information.

FIGURE 1. NATIONAL INFORMATION NETWORK



Clientele service and development

Through Information Services:

- —Full-time marketing specialists.
- —Management consultation.
- —Innovative user training.
- —Liaison officers.

Through the National Organization Body:

- —Inducing change within the education system.
- —Using venues of professional and trade associations.
- —Stimulating the development of information engineering consultants.
- —Sponsoring advertising and public relations campaigns via mass communication media.
- —Instituting programs of rewards and awards for exemplary usage of information.
- —Preparing of national manuals to guide information handling and procurement procedures in the user environment (these may include searching; publishing; record keeping); computer purchasing and leasing practices; management of information services; etc.

Means

Financial resources

- —Grants.
- —Annual Egyptian budgets of ASRT.
- —Resources provided by user sectors.
- —Funds from information-related projects.

Human Resources

- —Local training of over 1000 persons through an intensive program in modern information services.
- —Egyptian information specialists trained phase 1.
- —Consultants to provide specialized technical support.
- —Carefully selected Egyptian specialists to undertake technical implementation responsibilities.

Implementation Strategies

- —Maximum sharing of domestic information resources.
- —Maximum user participation in all phases of the project: planning, development and operation.
- —Maximum utilization of modern technologies such as microinformatics, distributed data bases.
- —Central acquisition of foreign document.
- —Common procedures and standards.
- —Central technical consulting team.
- —Centralized training.
- —Utmost emphasis on aspects related to stimulation of demand and broadening the user base.
- —Single governance mechanism.

Principal NIED Activities to date

The following activities have been completed or are being undertaken as part of Project NIED:

- —Surveying national information resources and user needs in Egypt.
- —Development of a proposed national information policy.
- —Completion of the general design work.
- —Development of a detailed manpower plan for the Egyptian information sector.
- —Preparatory work for a national union list of periodicals.
- —Completing a study of citation patterns of selected Egyptian journals.
- —A report on the current status of the National Information and Documentation Centre of Egypt.

About the major technologies used in NIED

- —Use of a mini-computer of 1.0 MB memory and 80 MB disc storage able to handle 15-32 terminals simultaneously.
- —Use of universal operating system portable from one model or brand of computer to another.
- —Use of readily available Data Base Management Software DBMS and query languages.
- —Utilization of modern techniques in automatic indexing, word-processing and storing of the thesauri and dictionaries.
- —Bilingual Arabic/English capability through the use of bilingual computer terminals and modification of DBMS software to store and retrieve bilingual information.
- —Use of universal standard protocols for internode information exchange as well as between NIED and external systems.
- —Utilization of the offered capabilities by Micrographics.

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Scientific and Technological Information Experiences in Jamaica: Problems and Future Prospects

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Introduction

The management and use of scientific and technological information in Jamaica is relatively new. Of course, persons directly involved with science and technology have always sought information in order to carry out their activities, but until fairly recently, there was no organized or methodical system of retrieving or disseminating information in Jamaica.

It is interesting to note that while we are discussing scientific and technical information, there is another kind of information which has been popular among those involved with electronic data processing (EDP). This type is found in the EDP systems referred to as management information systems (MIS), and is a logical sequential step in the development of electronic data processing by an organization. The normal function of a MIS is to enable the EDP user to glean information of any type desired from the EDP records. Thus, an organization involved in merchandising consumer goods is able to call upon its MIS to supply historical information on the rate of demand for a particular item, how that demand varied with seasons, and what the demand will be at a particular point in the future. Thus, a MIS is a useful tool for the use of a manager in an organization in carrying out his planning function.

With the growth in the use of mainframe computers in Jamaica during the 1970s by large business organizations, the use of MIS also became quite popular. The introduction of scientific and technological information (STI) principles and related systems late in the 1970s created a situation which it took some time to reconcile, since while "information" essentially means the same thing in both cases, the contexts and applications give different aspects to its meaning. Thus, a hurdle was created in getting persons already involved in EDP to appreciate scientific and technological information. We have recognized this in Jamaica, and have accommodated it in our approach to such persons. This brings us to the subject of problems encountered in pursuing the development of scientific and technological information systems.

Problems Affecting Development of Scientific and Technological Information Systems

Not only do we find it necessary, and sometimes difficult, to encourage persons with EDP experience to think in terms of scientific and technological information (STI), but we also have to orient, in this direction, the thinking of persons who need to use such information. As a developing country, Jamaica has not, historically, developed the principle of seeking after knowledge or information; this principle has only recently begun to evolve. Thus, an appreciation for science and technology, first, and then for scientific and technological information needs to be developed, and several avenues are being followed towards this end, as it is clear to the policymakers that national development depends to a very great extent, on our application of science and technology.

As mentioned before, orientation of the thinking of persons who need to use scientific and technological information is necessary. In recent years, Jamaica has witnessed a mushrooming of the number of small businesses, to the degree that, in number, small businesses far exceed the medium-sized and large businesses, and also produce a very large share of the the gross domestic product. This has resulted from the economic changes during the depressed 1970s and the rapidly increasing oil prices during the same period. Most of these businesses are mercantile in nature, but a significant number are involved in manufacturing.

Traditionally, our small businesses are originated by an individual having some money to invest and looking for a field for investment; and as the mercantile field offers the most rapid returns, most such investors enter that field. However, the field is fraught with problems involving external trade. Another attractive field, which has fewer problems with trading, is the manufacturing field. But what should an entrepreneur manufacture? He has no technical training, and he is looking for profits. He usually seeks either a well-proven field like food processing, or a licensing arrangement with a well-established brand manufacturer. A few who are more adventurous seek out new fields, but usually enter them without fully counting the cost and either do not get the best returns on their investments or fail outright.

It is to the manufacturing entrepreneur in particular that the thrust in orientation towards scientific and technological information use needs to be made. Large manufacturers usually have specialists on staff to handle areas calling for information inputs, and sometimes have their own research departments.

Another problem related to the pursuit of scientific and technological information that has been observed with several small and, surprisingly, a few large manufacturers is the implementation of decisions to either change product lines or

add new product lines. The desire to effect the change at least possible cost causes the manufacturer not to seek vital information for his operations, and he ultimately ends up with higher final costs.

Thus, the need to seek scientific and technological information by persons in or entering the technical world is a subject which our scientific and technological information network is trying hard to convey to such persons.

Technology Transfer

Mention has been made of licensing arrangements made by some entrepreneurs. This falls in the field of technology transfer, which also embraces royalties on patents, sale of rights, and so on. It has recently been discovered that many of our manufacturers do not get the best value for what they are paying; and this is due, once again, to lack of appropriate information. This matter is being addressed in Jamaica.

Another aspect of this problem is the matter of the "appropriateness" of the technology which has been transferred. It is noted that the Vienna Programme addresses and encourages transfer of technology from developed to developing countries, either free or on favourable terms. Whilst this is certainly to be encouraged, a word of caution is necessary. How appropriate is the technology? Can it be used as transferred? This is where S&T information has an important role to play.

It has been said that today's developed countries are developed because nearly a hundred years ago, they applied themselves to S&T development and are today reaping the fruits of it. The developing countries are only now finding the secret, as a result of the trend in recent years towards national and economic independence. Having the track record of the developed countries as an example, they need not take another hundred years; they only need to recognize where they are and chart a plan to go to where they wish to be.

The technology use in developed countries is essentially advanced technology, which is often not suitable for use in developing countries, with a few exceptions. Yet, developed countries often pass on technologies which are suitable for the recipients, but which have been outgrown by the developed countries. By the same token, it sometimes happens that technologies evolved in the developing countries are transferred to developed countries.

What is needed to bridge the gap is the part played by scientific and technological information in adapting technology as needed, for application in developing countries—this apart, of course from the country's developing its own appropriate technology.

One area in which advanced technology is appropriate on all fronts is in the area of computers. Admittedly, whilst the developed countries are using computers in all aspects of daily life, the developing countries are still struggling with the social aspect of computerization. Thus, whereas users in both developed and developing countries are equally enthusiastic about fifth generation machines (if they may be so called), the application of these machines varies widely. In developed countries, they will be used for videotext telephone calls, paying bills, carrying out bank transactions, shopping for goods, and the like. In developing countries, they are limited to data processing and process control.

Satellite communications are universally applied by both developed and developing countries. Yet, once again, developed countries will use this communication medium for data transmission, electronic mail, and the like, while developing countries are only beginning to progress beyond its use for voice transmission. The use of satellite communications for data transmission outside developed countries is normally carried out by multinational corporations, for processing information among their far-flung branches.

While on the subject of multinational corporations, it may be worth while to mention that they often face conflicts as far as appropriate technology is concerned. What may be appropriate for an operation in one country may be inappropriate for the same operation in another country. Nevertheless, the corporation needs to ensure that such technology as is appropriate is applied in achieving the objective of the operation. A case in point is the matter of safety systems used by Union Carbide at their pesticide plants in the United States and in Bhopal, India.

We do not have problems that serious in Jamaica, but we have others. A small percentage of the population is unable to read or write, yet these people must live, so they find employment in simple jobs. As technology advances, these jobs tend to disappear. Sociologists are looking at this problem, and emphasizing the need for the populace to become fully literate and also to have an understanding of the changes taking place about them.

Documentation and Archives

A good deal of Jamaican folk history is not recorded. It has been passed on from one generation to the other by "word of mouth"—orally. This has been recognized by the government, and steps have been taken to record such history—particularly as the increasing use of international communication gradually orients popular attitudes of young people, in particular towards the mores of developed countries.

The same applies to technology. Steps are being taken to document what may be described as folk technology—technology developed indigenously by observation over the years—lest it be lost to future generations.

Of course, having documented technology, whether folk or otherwise, we also need to develop the will or the desire to search the records for information. Too often have we attempted to "re-invent the wheel", when checking our information system would have sufficed.

Communication Systems

With our steady growth in industrialization, we have been taking steps to promote the availability of technical information among those who need it. For information available from local sources, the cost of accessing the information is small, but accessing overseas sources is proving quite costly, as the parity of the Jamaican currency has declined to a low value in recent years. This is a disincentive to information seekers—especially when the information is needed quickly.

Prospects for the Future

In recent years, a science and technology policy has been prepared for Jamaica. Among its many objectives is the development of an awareness among our populace of science

and technology, and its role in both daily life and national development—in other words, popularization of science and technology. The view here is that when the nation's thinking is oriented in this direction, the demand for information will naturally follow; the scientific method will be applied to the solution of problems; and national development will follow a technological orientation in our thinking as a people. This policy has not yet received official sanction. However, its tenets are being followed by those who are involved in fields related to science and technology.

Scientific and Technological Information

Jamaica has established a Science and Technology Information Network (STIN) linking the technical information systems of various technical organizations in the country.

So far, information exchange has been carried out by documents. Steps are now being taken to mechanize the network, both for reference on location and for remote reference. To achieve this, a uniform data base will be developed and computerized at each location, and the computer users linked by communication lines in due course.

The focal point for our STIN is the Scientific Research Council, which is spearheading the development of the computer network.

Steps are also being taken, thanks to the United Nations, to develop a network system in the Caribbean area, known as CARSTIN. I am happy to say that Jamaica has been selected as the focal point for this network.

Among the advantages of these networks will be the elimination of duplication of research and development activities, and simplified transfer of technology. In this connection, it should be mentioned that this network will be linked to various other international networks, as exist in the United States, Canada, France, and other countries, and also to the focal point of the Global Network when this is established, as recommended by the Vienna Programme.

Scientific and Technological Information Experiences and Activities in India: Problems and Future Prospects

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Introduction

India is amongst the few developing countries which have policies committed to the application of science and technology for national development. Ever since National Independence in 1947, the political leadership in India has made conscious efforts towards the promotion and growth of science and technology in the country. Such a commitment has been specifically expressed in the two major policy documents of the Government of India viz. (a) Scientific Policy Resolution (SPR), 1958; and (b) Technology Policy Statement (TPS), 1983.

The growth of science and technology in India has been characterized by increasing allocations for science and technology activities over the successive plan periods as well as by the visibly increasing infrastructures in the form of technical educational institutions, national laboratories and research institutions, and scientific departments for various sectors (e.g. agriculture, atomic energy, space, electronics, science and technology, scientific and industrial research, defense research, environment, ocean development and non-conventional energy sources), as well as an increasing number of science and technology personnel. This growth in science and technology activities has had an indirect effect on the growth of industrial activities in the country, together with an interesting amount of research and development activity in the industrial sector.

The growth of science and technology activities has also been taken note of in the socio-economic development plans of the country, and over the last decade conscious efforts have been made to integrate the socio-economic development plans and science and technology plans.

The scientific community and the government are becoming more and more aware of the pervasive role which scientific and technical information plays in socio-economic development. Scientific and technological information has begun to be regarded as a vital national resource. The period 1974-1979, which covered the country's fifth socio-economic Five Year Plan saw for the first time an emergence of the science and technology plan that was prepared by the National Committee on Science and Technology. In this plan, various general sectors of the economy, as well as specialized sectors of science and technology, were looked at together; and the sector of "information" was given special attention in its own right. In the following paragraphs, an attempt is made to describe various activities connected with scientific and technical information which have evolved in the country during the past decade or so; and based on the experiences and the problems faced, a future approach is suggested for setting up an integrated national information system for the application of science and technology.

Planning for a Science and Technology Information System

Having recognized the important role the information sector plays in the application of science and technology for development, the fifth Five Year Plan (1974-1979) placed considerable emphasis on the need for a national science information system. It was recognized that the primary object of an information system is to provide research workers, scientists, engineers, technicians, and managers and generally all who have some part to play in scientific activity with access to the information they need and to do this as economically as possible. The basic plan of action was to build a national information network using the existing infrastructures, by co-ordinating present activities, articulating the various services, developing their strong points, encouraging private and public initiatives, and filling in existing gaps.

In planning and evolving a national information system relating to science and technology, the requisites were identified as listed below:

Good communication facilities linking the users to the network of information centres and interlinking within the network;
More effective use of existing telecommunication facilities and development of new communication facilities for efficient operation of the system;
Support for scientific publication activities, including the establishment of a national science press;
Provision of information resources (libraries, documentation centres, etc.), with adequate collections of all types of documents;
Facilities for training in library and information sciences and communication;
Good organizational system using modern management techniques and financial procedures; and
Standardization in materials, techniques, and patterns of service.

Having outlined the broad issues and identified the requisites, the Government of India proceeded with the concept of

the establishment of a national information system which would embrace the following objectives:

> Provision of a national information service relevant to present needs and capable of development to meet the future needs of the generators, processors, disseminators, and users of information;
> Optimum utilization of existing information services and systems, and the development of new ones;
> Promotion of national and international co-operation and liaison for the exchange of information;
> Support and active encouragement of the development of facilities for education and training in information science and technology and in communication, to provide qualified manpower for the implementation of the national science information policy;
> Support of, and active participation in, research, development, and innovation in information science and communication, to enhance both the efficiency of information services and the quality of information provided by these services; and
> Support and promotion of research, development, and innovation in information technology.

The period 1974-1984, which essentially covered two Five-Year Plans for the country, has seen the growth of a variety of information centres and structures taking shape in scientific institutions and government departments, industrial establishments, educational institutions, and the like. The growth of these national activities in the area of information systems for science and technology, and their corresponding linkages with international systems, is described below and is based on the policy guidelines and approaches described above.

National Activities in Information Systems in Science and Technology

The growth of information infrastructure in the country has been very closely related to the growth of science and technology institutions in the country. Ever since 1947, a number of specialized scientific departments have been set up from time to time, based on the requirements of each sector of science and technology and its relevance to national development. Out of these structures, as well as through the mechanism of setting up autonomous structures, we have now in the country 138 universities, 320 national institutes and laboratories, and more than 900 industrial research and development units. There are scientific departments under the Government structure (atomic energy, space, electronics, science and technology, scientific and industrial research, non-conventional energy sources, defence research) as well as major organizations for agricultural and medical research; and under these establishments scientists and engineers are carrying out research and development activities which need a very strong information base in the form of libraries containing journals, current literature, and the like. These organizations have therefore developed major information systems independently, on their own. In addition to the scientific departments, there are other science- and technology-related sectors, such as industry, steel, irrigation, mines, textiles, which have also developed their own information centres satisfying their limited requirements. An illustrative list of the existing information infrastructures in various Government and other organizations is given in Table 1.

The information infrastructures belonging to individual organizations are each in different stages of development and are not interlinked in a systematic fashion. Mechanisms for collection and dissemination of information have not all been systematically organized. Requirements for trained manpower are being increasingly felt, with modern developments in information science. The libraries of many of the institutions under the governmental organizations need to be modernized using late technologies, so as to save space and provide quick and efficient service.

While formulating the overall framework for a National Information System in Science and Technology, the fifth Five-Year Plan took note of the growth of individual scientific departments and their information infrastructures. It was felt that these infrastructures could be integrated properly in a configuration called the National Information System for Science and Technology (NISSAT). Under the framework of NISSAT, to start with, a few sectoral information centres have been set up over the last five years or so. These have been in the field of food, leather, machine tools and drugs. The information centres are expected to provide scientific and technical information to specialists working in these fields all over the country. It has not yet been possible to ensure fuller and wider utilization of these sectoral centres while the host institutions specializing in these areas have been able to benefit from them extensively. The overall development of the NISSAT programme has yet to take place, though a beginning has been made through these sectoral centres.

In addition to building up the information infrastructures in scientific departments and institutions, as well as building up the information centres, there has been an increasing awareness of the utilization of international information systems which have been set up by specialized agencies under the aegis of the United Nations system. In order to utilize effectively these international information systems, national focal points have been identified within the country. These are all based on a sectoral approach and have not necessarily been interlinked for the purposes of taking an overall development approach. A list of national focal points for international information system is given in Table 2. Most of the international information systems subsist on national inputs from these focal points. Though in several cases the supply of inputs has been maintained effectively, information dissemination activities from these global data bases to the potential community of national users need to be stimulated. In view of this situation and the proliferation of focal points, as well as the recognition of the interdependence of science and technology activities in development, it is felt that there is a need to co-ordinate these activities at the national level. Such an approach is also expected to help in developing a sound base for information centres adequately equipped with modern hardware and software compatible with each other as well as with the international systems. Such a co-ordinated approach will indeed be necessary to strengthen the overall national information system in science and technology.

Based on the expertise available to individual infrastructures in various Government departments, several attempts have also been made to experiment with new techniques of acquiring global data, as well as communicating and interlinking various information centres. These experiments have used the hardware and the sophisticated techniques provided by international efforts. The experiments have given rise to a certain amount of confidence in attempting major exercises

in global networking. However, these experiments have not been transferred to real-life operational systems and should therefore be considered as not fully effective. Perhaps a co-ordinated approach, based on a national interlinking of information centres, will increase this capability and enhance the utilization of major experiments involving international linkages.

In recent years, the activities of the National Informatics Centre (NIC) set up in March 1977 under the Electronics Commission/Department of Electronics, Government of India, have played a very important promotional role in creating appropriate information systems. The centre has been charged with the total responsibility for providing informatic services to Government Ministries and Departments to catalyze decision making in Government. The centre has assisted in designing, developing, and implementing advanced computer-based methodologies and promoting the adoption of computer based data management techniques. It has helped to supply specialized manpower in the field of informatics and has been able to initiate activities connected with several intra-city and inter-city computer networks required for interconnexion between various Government departments. The Centre is also responsible for developing the information systems required for various sectors, such as finance, trade, agriculture, industry, construction, transport, education, and manpower. In many of these fields it has already made advances. The National Informatics Centre network, located in New Delhi, is based on a large computer system, CYBER CDC 170/730, which was acquired in May 1980 with the assistance of UNDP and has peripherals adequate for the comprehensive role this centre is expected to perform. It has already installed mini-computer-based intelligent terminals in different Government organizations in New Delhi.

Another major information centre which caters to the requirements of the scientific community is the Indian National Scientific Documentation Centre (INSDOC) established in 1952 under the Council of Scientific and Industrial Research (CSIR). INSDOC provides services such as procuring documents, photocopying services, bibliographies, reference information, and translation services. It also provides services in the form of information publications such as *Indian Science Abstracts*. The INSDOC has also regional centres at Bangalore, Madras, and Calcutta.

The libraries and technical information services provided by major organizations such as Bhabha Atomic Research Centre, the Indian Agricultural Research Institute, the Directorate General of Health Services, and the Indian Standards Institution also provide a very useful information base in their respective areas of interest.

During the last few years, new initiatives have been taken, through an inter-ministerial project co-ordinated by the Department of Space, in developing a National Natural Resources Management System (NNRMS). This system is being evolved to promote the utilization of the Indian remote-sensing satellite data on matters relating to the national resources required for major sectors like agriculture, mineral resources, hydrology. This system, when fully operational, will perhaps be an example of using interdisciplinary technologies as well as an integrated approach to resource management. In the area of the environment, efforts are being initiated to develop a major environmental information system, using network concepts, through the efforts of the Department of Environment. The efforts of the Department of Science and Technology have been mainly to evolve, in a phased manner, the concepts concerned with the development of NISSAT. As mentioned earlier, to the present moment efforts have been concentrated in the drug, food, leather and machine tools sectors.

Existing activities in the field of developing information systems for science and technology are necessarily based on decentralized infrastructures available in specialized departments or ministries connected with science and technology. Efforts are under way to evolve a comprehensive and integrated approach for linking these information infrastructures in a network. It is only when such an exercise is complete that we can consider that we have accomplished the truly national information system for science and technology which was envisaged in the fifth Five-Year Plan.

Some Problems and Future Prospects

As indicated above, during the last decade or so national activities in the area of science and technology information have grown, in widely varied fashion in several research and educational institutions, Government departments, industries, and the like. Each has attempted to serve the requirements of the users directly concerned with that sector or institution. However, the rapid growth of scientific institutions and departments has to a certain extent hampered the growth of an integrated approach to a national information system for science and technology. In a vast country like India, with governmental structures operating relatively independently, it has not been possible to evolve a well-co-ordinated information system for science and technology in the overall socio-economic development of the country.

A major problem which has contributed significantly to the lack of a co-ordinated development of information systems has been the rapid development in the technologies connected with generating, processing and disseminating information. Modern technologies, involving digital data communication with the use of satellites, as well as rapid development in microprocessing capabilities and sophisticated computer systems, have reduced the time gap required for generating, processing and disseminating information. Information received on time is extremely valuable, and hence these modern technologies play a very important role in the operation of information systems. Nevertheless, the technologies often depend on large capital investments and the supply and maintenance of sophisticated equipment which is not necessarily produced indigenously in a developing country. As a result of rapid technological development, the choice of hardware and the corresponding development of the software requires trained manpower and specialized equipment. These are not always easily acquired, even in a large country like India. The professional manpower to use these modern technological developments has proved to be grossly inadequate. Modern technologies provide very useful methods of decentralizing collection and dissemination of information. However, this also implies the availability of hardware and—more importantly—professional manpower, often in remote parts of the country. Such manpower is not easily available except in a few well-endowed and modern urban-based technical institutions. Further, rapid technological developments also tend to result in rapid obsolescence, so that planning for the long-term requirements of an information system becomes difficult. It is, therefore, proposed that in the seventh Five-Year Plan (1985-1990) emphasis be given to the development of manpower of the quality required to set

up and operate an appropriate national science and technology information system. The needs of the information system will include both the bibliographic and management information required for scientific work and an integrated data base for decision making and policy formation in the field of science and technology. It is important to set standards in information handling and insure the compatibility of hardware and software; selectivity in the creation of data bases is also emphasized, so that information that will be generally needed is available; and so that a surfeit of information (which can result in waste, both of energy and money) is avoided. What is important is that information be readily available at low cost. The use of unnecessarily sophisticated hardware and the routine accessing of international information systems, where one has to deal with the high operational costs characteristic of advanced countries and with questions relating to copyrights, can make information expensive. It is suggested that the efforts made so far by individual institutions, government departments, and the like, should be integrated through joint efforts in evolving a comprehensive and appropriate science and technology information system. In this process, wherever possible, modern advances in information technologies must be utilized. The main objective of such a programme would be these:

1. To develop vital national science and technology information systems on the basis of compatible networking; and to evolve management patterns so that the information is easily accessible;

2. To establish linkages between various components of the information system within the country as well as with international information systems; and

3. To develop expertise in the field of information systems including training of personnel and support for needed research and development.

The basic approach in evolving such a national system should take into account the need for three different kinds of information, (a) scientific and technological information; (b) techno-economic information; and (c) management information.

The aim of *scientific and technological information* is to provide information for scientific research in specific disciplines in various scientific and technological fields. These might include the pure sciences (life, physical and chemical sciences) as well as applied sciences such as engineering. In each discipline, specific sectors (for example, aeronautics, food, leather, metallurgy, fertilizer, transport, petro-chemicals, mining, heavy engineering, and machine tools) could form the sectoral activities of the information system.

Techno-economic information is to provide information for development, production, and other economic activities which depend on scientific and technological inputs. This techno-economic information will be extremely important in planning the activities of Government departments responsible for the growth of various economic and service sectors; hence this information system should be integrated in the government framework through a centralized computer system providing data bases and terminals appropriate to the requirements of the Government departments.

Management Information Systems will also be required by planners, administrators and all those engaged in management of research and development information relevant to policy framing and decision making.

These three aspects of information systems are not independent and would have to be closely related and interconnected to each other. Here again, modern technologies can be utilized providing a network of sophisticated computer systems and data bases and using modern communication systems such as microwave and satellite communications.

Greater emphasis will also have to be given to research and development programmes in the area of information science itself, to aid the design, development and implementation of advanced computer-based methodologies and also provide specialized manpower in informatics to be used in building up an intra-city and inter-city computer network and interconnecting the various decision-making arms of the government.

Efforts in the building up of a modern information system in science and technology will have to be strengthened before emphasis is given to linking with an international science and technology system. A global information system coupled with regional information systems will no doubt prove very useful in interlinking different parts of the interdependent world, but it is necessary to stress that unless national information systems are developed, strengthening the endogenous capability for utilizing science and technology information, the main objective of setting up a global information system will not be achieved.

Conclusions

India has recognized the importance of developing modern and appropriate information systems in science and technology for national development. With the growing infrastructures for science and technology activities in the country, the need for such systems has also been emphasized in the socio-economic development plans of the country. While information sectors have developed in various educational and research institutions as well as in Government departments, it is felt that the integrated development of a national science and technology information system is essential; greater attention will be needed to the interconnecting of various independent information centres by use of the recent developments in computer networks based on modern communication technologies and using microwave and satellite linkages. While these developments show great promise for the development of a comprehensive national information system for science and technology, it is also recognized that there is a need to train the manpower required for the use and application of these modern technologies.

The need for a global and regional information system in science and technology will be justified only if a national information system for science and technology can be developed first, which can then be linked to the regional and global information systems using modern technologies.

Table 1. Information systems and centres in government organizations in India
List not exhaustive

Organization/agency	Information systems/centres	Related sectoral activities
Department of Electronics Electronics Commission	(a) National Informatics Centre and NICNET	Computer networking with other government departments to provide techno-economic information
	(b) Regional Computer Centres and INDONET	Computer facilities to be used in different parts of the country giving information about various sectors
Ministry of Science and Technology		
(a) Department of Science and Technology	(a) Management Information System (MIS) being evolved	Providing necessary information to Science Advisory Committee to the Cabinet and developing information systems for various research and development activities in different agencies dealing with Science and technology
	(b) National Resources Data Management System (NRDMS)	Pilot-scale computer-based data bases on natural resources for micro-level planning
	(c) National Council for Science and Technology Communication	Promotion of new areas of science and technology and science popularization
(b) Department of Scientific and Industrial Research (DSIR) Council of Scientific and Industrial Research (CSIR)	(d) National Information System for Science and Technology (NISSAT)	Development of sectoral data bases for science and technology
	(e) Indian National Scientific Documentation Centre (INSDOC)	Promoting industrial and bibliographical information services. Access to global information resources and control of documents on scientific and industrial research
	(f) Publication Information Directorate (PID)	

Table 1 continued

Department of Space	National Natural Resources Management System (NNRMS)	Being evolved to promote utilization of Indian remote-sensing satellite
Department of Atomic Energy	Bhabha Atomic Research Centre	Providing information relating to research in atomic energy and physics
Department of Agricultural Research and Education (DARE)/ Indian Council of Agricultural Research (ICAR)	(a) Indian Agricultural Statistics Research Institute (b) Indian Agricultural Research Institute	To create data base for agriculture research
Defence Research and Development Organization (DRDO)	Defence Scientific Information and Documentation Centre (DESIDOC)	Documentation and information on science and technology related to defence research
Department of Environment (DOEn)	Environmental Information System (ENVIS)	Establishing network for creation of data base on different aspects of the environment
Department of Ocean Development (DOD)	National Oceanographic Data Centre	Marine research and development resources surveys
Director General of Health Services (DGHS)	National Medical Library	Documentation and bibliographical Information on health
Ministry of Education/University Grants Commission	(a) All Indian institutes of technology (b) A few universities	Creating information support on science and technology

Table 1 continued

Ministry of Industries	(a) KISSAT Sectoral Centre at Central Machine Tools Institute (b) The Small Entrepreneurs National Documentation Centre (SENDOC/The Small Industries Extension Training Centre (SIET)	Development of data base relating to industry and research SENDOC gives special emphasis to small-scale Industries
Department of Textiles	National Centres on Textiles and allied Industries contemplated at Association of Textile Industries Research Association (ATIRA)	Information relevant to textile industry
Department of Mines	(a) Geodata bank at Geological Survey of India (GSI) (b) Geodata bank at Indian Bureau of Mines	Data banks on geology and minerals
Department of Steel Steel Authority of India Department of Irrigation	Information Centre Central Water Commission (CWC) Central Water and Power Research Station (CWPRS) Centre	Iron and steel Irrigation and water resources

Table 2—National focal points for international information systems
List not exhaustive

UNISIST (UNESCO)	Department of Science and Technology Technology Bhavan New Mehrauli Road New Delhi 110 016
Marine Environmental Data Index: MEDI (UNESCO)	National Institute of Oceanography Niranar Panaji Goa 403 004
Aquatic Sciences and Fisheries Information System: ASFISO (FAO)	National Institute of Oceanography Niranar Panaji Goa 403 004
INFOTERRA (UNEP)	Department of Environment Bikaner House New Delhi 110 011
International Register for Potentially Toxic Chemicals: IRPTC (UNEP)	Indian Toxicology Research Centre Chattar Manzil Palace Lucknow 226 001
Agricultural Information System: AGRIS (FAO)	IASRI/Pusa Complex Hillside Road New Delhi 110 012
International Nuclear Information System: NIS (IAEA)	Bhabha Atomic Research Centre Trombay Bombay 400 085
Global Environmental Monitoring System: GEMS (UNEP)	National Environmental Engineering Research Institute Nehru Marg Nagpur 440 020
Food Science and Technology Abstracts (FSTA)	Central Food Technological Research Institute Cheluvamva Mansion V. V. Mohalla, P. O. Mysore, 570 013

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Hungary's Co-operation With Developing Countries In The Area of Scientific and Technological Information: Future Prospects

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The Hungarian scientific-technological information system was formed at the beginning of the 1960s in concert with the economic reform. Ever since, it has been developing continuously, adapting itself to needs and demands.

Together with this development, almost simultaneously, our participation in international co-operation was started. Its first aims were to get knowledge about the results of systems in foreign countries and to introduce our own work to others.

In 1967, at the time the UNISIST programme was started, Hungary participated in the preparation of the first intergovernmental UNISIST conference. This fact indicates that the Hungarian state attached particular importance to international co-operation in the field of scientific-technological information. The first contacts with developing countries were established within the various committees of United Nations organizations in three fields:

—Participation of our experts in the planning and development of national information systems, and as invited lecturers in several educational and training programmes;

—Organization of conferences and seminars with an emphasis on the participation of experts from developing countries, to exchange experiences;

—Establishing scholarships for students from developing countries, and the training of information experts in postgraduate courses, candidature, and the like.

Outside the United Nations family contacts, Hungary has established a system of bilateral agreements with most of the developing countries—intergovernmental and interinstitutional connections covering co-operation in information transfer and exchange. These relationships have many aspects, and comprise almost all possibilities between the traditional interlibrary loan and the elaboration of high-level consolidated information studies for state administration.

Some Results of Co-operation

Here are some examples of the co-operation between Hungary and the developing countries:

—The National Technical Information Centre and Library (OMIKK) organized three seminars on the standardization of information (mostly for experts in developing countries); the Institute published *UNISIST GUIDE* to *Standards for Information Handling* for UNESCO (1980, 304 pages); our staff members, as UNESCO experts, acted as teachers and lecturers in the Philippines, Indonesia, Portugal, and Laos.

—The plan for the organization of a national information system in India was outlined and elaborated by the former director of OMIKK; one expert helped in the development of the information services at the Industrial Development Centre of the Arab States in Cairo.

—Our libraries have established close links with many institutions in the developing countries for the exchange of publications. OMIKK alone has such contacts with nearly 100 institutions in 30 countries.

—Each year there are students from developing countries studying library and information science at Budapest universities; presently there are students from Ghana, Iran, and South Africa. Our universities are open to foreign students. Last year five people from Libya got candidature in library and technical information science. Another form of contacts is the invitation of trainees.

—Our information centres make efforts to provide students from developing countries, and graduated at various universities and colleges, with literature in their own tongues.

—The Vienna Programme of Action on Science and Technology for Development recommended that the developed countries should make their information resources readily accessible to developing countries. In Hungary we were and are ready to fulfill such needs, in most cases free of charge. Effective co-operation has been developed in this field with developing countries of the socialist type, first of all with Cuba and Viet Nam.

—Another type of co-operation is that our information centres have been rendering regular selective dissemination of information (SDI) services to those experts in developing countries who formerly studied in Hungary.

—The chairmanship and secretariat of FID(DC) (the Committee for Developing Countries of the International Federation for Documentation) were in Budapest for years.

—According to intergovernmental agreements, we compile on request complex information packages, critical reviews, and so-called "studies" for decision making by state offices in developing countries. In our experience, this is an effective form of co-operation. The materials are prepared in collaboration with experts from the country concerned; this helps in the establishment of national information centres and "focal points" demonstrating the importance of scientific and technical information as well as creating new demands for it. At the same time, local information scientists have the opportunity to acquire know-how in handling information and in methods to improve existing services.

Future Prospects

To improve our co-operation with other countries, we have investigated the fields in which Hungary—an averagely developed, relatively small country, with a language differing from those of its neighbours—can contribute to the establishment of national, regional and international information networks, and to the dissemination of scientific-technological culture.

We have also investigated the reasons why a developing country—usually one that is larger than ours and belongs to a larger language family, or at least uses a world-wide language officially—might wish to co-operate with us and not with a more developed state.

Hungary's special historical situation is that since she is a small nation, situated amidst Latin, German, and Slav states, the principal means of her survival as a nation has been to preserve her language. That may be the reason why we have a well-developed library culture, and with this as a basis, a developing, up-to-date information science. Although through her entire history Hungary has been short of capital, nevertheless her prominent scholars have always contributed to the universal culture. For example, there are ten Hungarian-born scholars among the Nobel prize winners. This special situation is responsible for the fact that instead of creating a sophisticated, mechanized background, we have had to seek for methods assuring that our information is equal in quality to that of the big computer-assisted information systems.

Conditions in one developing country to those in other developing countries are similar in many aspects. As L. Salvan stated (1981), in the developing countries in which great efforts were made to install the most up-to-date information devices, the system often could not operate efficiently because of inadequate infrastructure, e.g., lack of demand and other human factors.

We are convinced that as a first step the developing countries can best be supported by education and training. In the organization of their national information systems, methodological and practical guidance is desirable helping the country to achieve a level of proficiency at which it can join the international information systems.

At present Hungary is participating in the International Scientific-Technological Information System of socialist countries and simultaneously co-operates with important international data centres; she uses the greatest data centres of western Europe and the United States. We are considered to have an advantage as compared with information centres of Socialist countries because of the fact that economic reform in Hungary made it possible for OMIKK, as the leading institute of technical information, to establish close direct contact with information users, research institutes, enterprises, and government offices.

Information services in Hungary have been forced to face various challenges. We also have been influenced by the information explosion which resulted in computerization of information institutes throughout the world. In Hungary, computerization could not be completed because of the shortage of capital. In addition, because of the economic reform mentioned above, beginning about the same period, the nature of our information needs was basically altered. This trend is still in progress. In the updating of our national system, we are searching for new methods and techniques in support of industry to decrease the lag of our national economy behind those of the more developed countries.

Our efforts match those of other developing countries; and our co-operation with them is aimed to exchange knowledge of each other's experiences, to utilize this knowledge in establishing regional information systems, and to try to overcome the problems caused by the shortage of capital by a joining of our mutual efforts.

Scientific and Technological Information in the Development Process: the Case of Honduras

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General Characteristics

Honduras is a small country, both in geographical and economic terms, and its economy is quite open.

Its best known resources are agriculture and forestry. Since the latter are relatively more abundant, one might consider that its economic structure should be based on exploitation of forestry and on the development of its intersectoral productive linkages. But the economy of Honduras is based mainly on agriculture. This is reflected in employment, in concentration of population in rural areas, and in exports. In the sectoral composition of production, agriculture continues to be the major resource. Notwithstanding the considerable significance that agriculture has in the economy the intersectoral linkages which resulted so far are few.

The diversification of the productive structure is quite recent, starting during the 1950s and increasing during the 1960s, when the country participated fully in the process of economic integration in the Central American subregion. Since then, the manufacturing capability has increased, geared towards the production of consumer goods and some raw materials for such industries. Despite such trends, the economy remains essentially agricultural.

However, agricultural development has not been homogeneous. There exist two production structures: one geared towards exports, and the other towards the internal market. Agricultural production for export has been protected by governmental policies resulting in the concentration of financial, managerial and institutional resources for this purpose. The level of its technological development is high and extensive. Agricultural production for the internal market has been operating in an opposite direction with meager resources and on a low level of technological development.

It should be noted that not only in agriculture but also in forestry and mineral exploitation foreign investment has been significant, usually in isolation or without significant linkages with the national economic structure. On the other hand, the manufacturing industry has utilized a mode of production with imported machinery and technological processes, further reducing the intersectoral linkages.

Organization of Science and Technology

The structural characteristics of the economic growth of Honduras, mentioned above, have inhibited the emergence of a national scientific and technological system and the process of local technology generation, notwithstanding the existence of isolated elements of sectoral character, such as in the agricultural export, or for specific products, such as the banana.

Enterprises involved in banana production have maintained specialized institutes which also deal with other tropical crops, but basic research related to such products has been carried out mainly outside the country.

To improve agriculture production for internal markets, a government research and extension service has been established during the fifties, meant to carry out genetic improvement and selection programmes.

Scientific research has not been performed in the country prior to the recent establishment of agronomy and engineering schools, the lack of which limited the availability of personnel and institutional structures necessary to carry out such activities. Furthermore, since the necessary technical information had to be acquired outside, the possibility of mobilizing resources for local technology generation was further reduced. Even the function of adapting technologies acquired externally has been performed in a limited fashion, since this would also require trained personnel.

In the manufacturing sector, there was no demand for scientific research and technological development, and technology was thus obtained from abroad.

In other words, not only no special organization was available for technology generation, but also its adaptation has been performed sectorally, and for specific products, in a limited fashion. Only a few nuclei for research and technological development can be found in the private sector.

In the remaining productive and service sectors no research and development has been carried out and the technology employed has been imported.

With the exception of the agricultural sector, especially for the production of banana, no significant financial resources have been mobilized for research and development. The same situation applies in the field of human resources, which are concentrated also in the agricultural sector.

Applied research and experimental development have not been carried out regularly and increasingly. The configuration of a socio-economic context linked with foreign scientific and technological systems generated this type of technological development process.

Technological inter-mediation acquires great relevance as a means to link the supply of foreign technology with the requirements of the productive and service sectors. Actually, technology import for direct and immediate use has taken place more often. However, as the industry and agricultural export grow, a slow and limited process of technological adaptation develops, entailing the creation of a small nuclei of technological research.

The need of Technological Information

It is within this context of scarcity of human resources, limited financing, poor research infrastructure, low demand for local technology and reduced intersectoral integration that the process which requires scientific and technological information is to take place.

Due to the low requirements of local technologies, there has been no significant demand of basic scientific knowledge. Indeed, studies conducted show insufficiency in basic disciplines, except in biology, which is not particularly strong either.

In such circumstances, the need for a scientific information system does not become acute. The fragility of both governmental and private research institutions tends to reinforce the attitude that such activities can only be performed in the industrialized countries. Therefore, information is required to meet teaching needs and is mainly provided through universities' libraries.

The organizational schemes for technological information presents the same characteristics of concentration found in the economic and social structures. They exist in the agricultural sector, small and medium enterprises, consumer and some intermediate products and in the construction sectors.

Currently two units are responsible for the technological information service for the manufacturing and construction sectors. Both units are part of a regional project supported by OAS and are linked to the Central American and Caribbean network. One is in the School of Engineering of the National Autonomous University of Honduras, created in 1976. It services industries such as leather, wood, mechanics, and construction. The other unit is at the Honduras Central Bank and is responsible for information for food and chemistry industries, as well as for small and medium enterprises.

Under the responsibility of the Industrial Development Center, created to support the small and medium enterprises, an Information Services Unit has been established to provide for the need of rural technologies.

Within the General Direction of Agricultural Operations of the Ministry of Natural Resources, a Center for Agricultural Documentation and Information has been created. It provides for scientific and technological information needs relating to the study and solution of agricultural problems.

The services rendered by these centers can be seen in the following table.

Services rendered by the Technological Information Centers

Name of the Institution	*Written Query and Answer*	*Technical Consulting*	*Publications*	*Library*	*Translation*	*Content*
Centro de Informacion Industrial Banco Central de Honduras	X	X	X			
Centro de Informacion Industrial Universidad Nacional Autonoma de Honduras	X	X	X			
Centro de Documentacion e Informacion Agricola, CEDIA	X	X	X	X		X
Unidad de Servicios de Informacion y Relaciones Externas, USIRE del Centro de Desarrollo Industrial, CDI	X	X	X	X	X	

Source: Survey of the main technological information centers. CONSUPLANE, 1984. Honduras.

A gap which can be observed is the lack of utilization of the technological information contained in patents. Still there is no service for processing, storage, retrieval and dissemination of information from this type of source. No center exists also for the collection and evaluation of information related to changes in the industrialized countries, which might affect present activities in countries such as Honduras, or offer new development opportunities.

The need for training personnel in handling of information is recognized, as well as in the utilization of automated equipment and in the design of arrangements and procedures needed to satisfy progressively the requirements of the users. The lack of articulation between the goals set for services rendered and the actual needs of users are also recognized.

At the users level, the lack of a favourable attitude to utilize scientific and technological information to upgrade production schemes is observed. This is linked with the inability of the educational system to develop such attitude on the part of students and teachers, as well as on the part of the direct users of technology, at the productive level.

It is also considered necessary that the schemes for handling and providing scientific and technological information be adapted to the conditions of scarce financial resources.

Scientific and Technological Information and Documentation Activities in the Socialist Republic of Romania

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In the Socialist Republic of Romania, information and documentation are regarded as components of the activities of scientific research, technological development, and implementation of technical progress; and is centered in a National System for Scientific and Technical Information. This approach is reflected in the legislation of the country.

From a structural point of view, this activity is regulated under Decree No. 138/1974, which ensures a unitary structure as well as the co-ordination of the activities carried on by the information and documentation units, in order to avoid duplication and to utilize with maximum efficiency the capacities existing in this field.

Presently in Romania there are 26 information and documentation office (centres), structured according to the branches and fields of the national economy, as well as a much higher number of divisions for technical information organized at the level of the units for research, design and engineering in the institutes for higher education as well as within the enterprises. Specific technical information and documentation activities are also carried out within the State Office for Invention and Trade Marks and the Romanian Institute for Standardization, as well as within public and specialized libraries (over 2,090 units), within the network of libraries existing in the higher education units (43 large libraries), and within cultural establishments specializing in problems concerning the promotion of mass technological and scientific creation, such as the Houses for Scientific and Technological Creation by Youth, which exist in each country as well as as in the main towns of the country.

At the national level, methodological co-ordination and the implementation of a rational division of labour for this huge and extremely diversified range of activities involving different fields and carried out all over the country are administered by the National Institute for Information and Documentation and directly co-ordinated by the National Council for Science and Technology.

The main tasks of the National Institute for Information and Documentation (NIID) are the following:

—Promotion of modern (automated) means of information processing, providing for the technical compatibility of information and documentation units at a national level as well as for the compatibility of the national system with other national and international systems;

—Co-ordination of acquisitions of primary and secondary sources of information and documentation within all the units of the system, according to the national labour-division principle regarding information processing:

—Providing for a methodological approach to information processing within all information and documentation units, through the application of certain technical standards and methodological documents, and of documentary languages at a national level;

—Co-ordination of subject-oriented plans for publications and for services to be performed by the information units, in order to avoid duplication of themes and to stimulate the mutual exchange of data and information materials;

—Information to top management on the newest national and international developments in science and technology having a strategic significance in decision making regarding guidelines and trends in the plans for future developments of the national economy and economic units;

—Information to specialists in research, design, education, and industry, on scientific and technological evolution in multi- and interdisciplinary fields;

—Promotion of international co-operation in the field of scientific and technical documentation.

From the viewpoint of the targets established at each stage, information and documentation activity is regulated according to program-oriented documents of the utmost importance for the country's socio-economic and technico-scientific development. Thus the Directive Programme of "scientific research, in the 1981-1990 period and the guidelines until 2000" states as one of the highly complex tasks the continuous improvement and increase of efficiency of scientific and technological information activity which "has to contribute to the fast dissemination of the newest developments of science and technology, both in Romania and abroad, among all the research and design staff". With this aim in view, a better systematization and utilization of the documentary funds is being provided, along with continuous updating through the increase of acquisitions and of information exchange with both internal and foreign partners, and through the increased efficiency of information flow between research and design units and enterprises.

The Directive Programme also contains steps to be taken for the continuous improvement of the structure and activity of scientific and technical information and documentation units by equipping them with modern means for the collection, storage, processing, and dissemination of information,

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including concentration in data banks organized by branches and regions.

The National System for Scientific and Technical Information and Documentation operates on this basis. Making use of the most advanced techniques and methods, this system provides for a unitary and operative fulfilment of the following fundamental tasks:

1. Providing the most relevant information and documentation sources from within the country and from abroad, through the promotion of a national policy regarding acquisitions according with the needs of the users in the national economy;

2. Providing rapid and easy access by all persons concerned to any information source existing in the country, regardless of the place of storage;

3. Current dissemination among users of the newest scientific and technological information, which according to subject and content provides the necessary data for the priority tasks in development of the national economy;

4. Rapid processing, storage, and retrieval of the scientific and technological information necessary for research, design, and industrial development in the structure and amount required and whenever necessary.

According to our experience, the integrated fulfilment of these tasks at a national level raises a series of complex, technical, methodological, and structural problems. Among these we can mention the questions regarding the centralization or decentralization of information and documentation; the major importance of these considerations in providing the optimum information, they also afford an opportunity to review certain basic activities of the Romanian National System for Scientific and Technical Information and Documentation.

The traditional communication channels in science and technology handle diffuse, unoriented information flows; this information is generated in mass proportions and directed issues toward unspecified users, a fact which reduces greatly the efficiency with which the information's used. For these reasons one of the important tasks of the System is to structure and selectively direct these information flows to their specific users. To this end, this activity should be carried out as close co-operation as possible with the users, so as to adjust easily to changes in the structure of their information needs. This requirement calls for a decentralization in the information and documentation activity which has to be kept in mind when designing national systems. Nevertheless, at least two arguments can be advanced against exclusive application of the decentralization principle:

—The limited capacity of the information and documentation departments and of the teams within the units, and (implicitly) their limited control over primary information sources; and

—The economic difficulty in applying this principle resulting mainly from the inherent duplication of efforts, i.e. in the processing of information sources, in translation and in developing certain scientific research works, inventions, innovations, and the like.

These disadvantages can be avoided only on the basis of a dynamic equilibrium between the decentralized activities and the centralized services which are intended to co-ordinate the work of the system. This equilibrium can result in a maximum efficiency with the application of the following principles:

1. Each document should be subjected to a single processing, and then it should be sent to all the potential users of its information content. This procedure embodies a strict division of labour in the processing of information (decentralization); and at the same time a rigorous control over the sources and over the informational outcomes (centralization). The results of implementing these principles are advantageous both from an economic viewpoint (avoiding duplications and the consequent expense) and from the viewpoint of a better utilization of the systems capacity enlarging and intensifying the flow of information.

2. The compatibility and methodological unity of the subsystems belonging to the National System should be provided for, and the same time should be sought in relationships with other national systems so that both national and international information exchange can be conducted with minimum effort and cost. This requirement can be met only by a methodological centralization of the entire system, i.e., the development and implementation of a unique methodology regarding documentation, description, summarizing, indexing, and classifying, according to existing international standards.

3. The principle of a single recording of the information in the memory of the National System for Information and Documentation should be applied, with documentary memories being automated, as well as their connection to the data base distribution networks.

The simultaneous application of centralization and decentralization in the activity of the National System for Information and Documentation aims, on the one hand to reduce effort and expense through central recording and control of all activities so as to avoid duplication; and on the other hand, to provide better information to the users, according to their requirements. With centralization, stress is laid on recording and co-ordination under the conditions necessary for the operation of the system, while with decentralization stress is laid on the analysis and use of information by direct contact with the user according to his information requirements.

The activities which were to be centralized include a series of national record files divided according to the category and type of documents covered. These, apart from the advantages pertaining to the operation of the system, represent an essential tool in the management of the system, because the information these record can support decisions in information and documentation policy concerning the accessing of information sources, their territorial distribution, their balanced share of the processing operations, and supervision of the activities carried on. On the other hand, the national record files are real sources of scientific investigation. They enable the diagnosis and the forecast of social phenomena that are difficult to control if such record files do not exist. Therefore, a reference data base, including all national or international publications specific to a certain field of activity (or to all fields of activity), can undoubtedly represent a powerful tool of analysis and forecast of trends in present-day science. The decision makers in science policy can thus be supplied with comparative data regarding national and international trends, and can on this basis determine their options in the guidance of national science research. An important advantage derives from the "general law of systems", according to which every system exceeds the sum of its components. This feature

makes a system of national record files an information tool whose value lies in this integration, and not in the simple accumulation of the functions.

At present, the following centralized national record files are in use in the Social Republic of Romania:

—The national record file of the acquisitions of foreign serials, established by the National Institute for Information and Documentation and managed by use of an electronic computer. Its main objective is the optimization of the national acquisition policy and minimizing the use of foreign currency by decreasing the number of copies per title while increasing of the number of subscriptions and the availability of the information covered by these sources:[1]

—The cumulative file of foreign book collections held by the libraries of the Socialist Republic of Romania, developed by the State Central Library in order to control the record of book holdings.

—The centralized record file of translations from scientific and technical literature managed by the National Institute for Information and Documentation, in order to avoid parallelism in information and documentation activity in this division and to facilitate access by users to scientific and technical documents originally published in languages of limited use, but already translated into Romanian;

—The centralized record file of the Romanian industrial catalogs and leaflets developed by the National Institute for Information and Documentation to provide information regarding products made in Romania, to reduce imports and to improve Romania's balance of exchange payments;

—The national bibliography of the Socialist Republic of Romania, produced by the State Central Library. It includes the entire production of Romanian technical, scientific, cultural, and artistic publication and is considered a valuable means of information as well as a significant instrument in the scientific and cultural policy of our country;

—The centralized record file of Romanian and foreign patents, established by the State Office for Inventions and Trade Marks;

—The centralized record file of Romanian and foreign standards, developed by the Romania Institute of Standards;

—The centralized record file of the doctoral theses submitted in Romania by Romanian and foreign authors and abroad by Romanian authors, developed by the Academic Central Library.

Some of these centralized record files have been already automated; others are being automated at present; while the automation of certain other record files is uncertain.

In future, the development of new record files is expected (and will include a series of unpublished documents), as well as a progressive integration of the present record files into a coherent national system. This step is without compromising the decentralized information and documentation activities in research, education, and production units which represents a significant and necessary aid to these activities which are an advantage to the national economy providing them new and useful services.

Reference

[1] Costs as measured by the recent increase in costs from primary sources in the world market; which is comparable with the increase in energy costs (from $US 60 to $US 200 in the period from 1979-1983).

Scientific and Technological information Experiences in Kuwait: Problems and Prospects

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Abstract

A brief description of special library activities and services in Kuwait is presented in the introduction. The experiences and activities of the National Scientific and Technical Information Center (NSTIC) of Kuwait Institute for Scientific Research (KISR) can be considered an example of the advancement of scientific and technological information systems and services in a developing country. In less than ten years, NSTIC has been able to build a sound organization, a research library with a core collection of 45,000 book titles, 1,800 periodical titles, and a technical report collection of 300,000 titles. NSTIC also has selected collections on patents, standards, and specifications; a special collection on Kuwait; and other related materials of interest in scientific and technical fields. Library resources have been organized and processed according to international standards, using computerized systems. Advanced information services such as on-line services, reference, current awareness, and selective dissemination of information (SDI), have been provided to both KISR and non-KISR users. Computer technology has been used in certain applications, especially for bibliographic control activities, including Union Catalogs of Books and Periodicals and other functions, such as circulation and acquisitions. Well-trained professional and paraprofessional staff have been hired and new recruits have been trained on-the-job and through professional seminars. A feasibility study has been conducted this year to determine ways and means for developing a special library network in Kuwait to promote co-operation and enhance dissemination of scientific and technological information among selected libraries.

This report ends with a review of the problems encountered and an outline of future activity towards developing a rational information network.

Introduction

Special libraries are relatively new to Kuwait. Their genesis dates back to the early 1960s with the establishment of the Library of the Chamber of Commerce in 1960. At present, there are 16 libraries that can be considered special libraries in scientific and technical fields and related areas. Of the 16 libraries selected for inclusion in a recent study of special libraries in Kuwait, 11 were government libraries, 2 were serving private institutions, and 3 belong to regional organizations. Out of 11 government libraries, 5 were identified as academic, namely those of the schools of science, engineering, commerce, and medicine of Kuwait University, and the library of the Kuwait Institute for Applied Technology.

The 16 libraries, including the National Scientific and Technical Information Centre (NSTIC) of Kuwait Institute for Scientific Research (KISR) have a total collection of 316,110 volumes in Arabic and non-Arabic languages—mainly English. Unique book titles in Arabic account for only 33,945 (29 percent of total book titles) while 177,870 are in English (71 percent of total book titles). The total periodical collection amounted to 10,567 titles, of which 82 percent are in English and 18 percent in Arabic. In fiscal year 1982/1983, an estimated budget of KD 1,710,000 (1 KD = $US3.3)[1] was spent on these libraries, of which KD 678,000 went to acquisitions (39.4 percent of the total budget) and KD 866,000 (50.3 percent of the total budget) went to wages and services. Libraries surveyed had a total of 162 staff members, of which 83 are considered professionals and 79 paraprofessionals.

Modern information services and computer applications have been limited and conventional methods prevail in most of these libraries except in the case of the National Scientific and Technical Information Centre (NSTIC). With adequate resources, budget allocation, staffing, organization, computer applications, and advanced user services, NSTIC has surpassed other specialized libraries in scientific and technical fields. The progress of NSTIC is presented in this paper as a case study of the development of a scientific and technological information system and its services in a developing country.

Background

Kuwait Institute for Scientific Research (KISR) was established in 1973, by an Amiri Decree "to promote scientific and applied research related to industry, energy, and agriculture and other fields necessary for economic and social development of the country". The Decree also emphasized the need for "providing scientific and technical information to government agencies, business and industry in Kuwait". For this particular purpose, the Documentation and Information Division was established that year.

In early 1976, the new KISR management emphasized the role of information in supporting research in KISR, and con-

centrated on developing a powerful information base for the country. The Council of Ministers issued an executive order to develop the Documentation and Information Division of KISR into a National Scientific and Technical Information Center (NSTIC) serving the whole country. The executive order specified that NSTIC "should function as a national focal point for a network of special libraries and information centres in Kuwait and later as a regional centre for the Gulf". It also identified the mission of the centre as "to collect, organize, disseminate, and identify scientific and technical information, to provide bibliographic and information services, and to encourage the exchange and transfer of documents on the national and regional levels. (See reference 1.)

NSTIC Organizational Structure

The centre was organized into two major departments, and a systems group, namely, Technical Services (TSD), Information Services (ISD), and Automated Information Systems Group (AIS).

TSD is responsible for collection development, including selection, acquisition, organization, and processing of all printed and non-printed materials. TSD consists of two sections, Acquisitions and Cataloging.

ISD is responsible for planning, developing, and provision of information services to KISR and non-KISR users. The department consists of four sections: Reference and Circulation, Specialized Services, Kuwait Information Centre, and the Marine Biology Library in Salmiyah, a research station outside the KISR campus. The Kuwait Information Centre merits a passing comment. It functions as a depository library for government documents and maintenance of the NSTIC specialized collection on Kuwait.

AIS is responsible for designing, developing and implementing computer-related systems and programmes to support in-house functions and bibliographic service activity. The group assumes responsibility for updating and maintenance of NSTIC bibliographic control programmes, including union and regional catalogs of periodicals and monographs used for identifying and locating material resources in Kuwait and the region. AIS also maintains a data base for the NSTIC on-line catalog, specialized indexes, and circulation control. (See reference 2.)

Budgeting

In fiscal year 1975/1976 (pre-NSTIC), the budget for library and information services did not exceed KD 40,000. With the development of a strong information base, budget allocations increased in the following years to meet the needs for collection development, manpower, facilities, equipment, maintenance, and operations.

By 1983/1984, the budget was KD 700,000. Of this, 46 percent went to wages and salaries, 43 percent to collection development and services, and 11 percent to operations and contingency funds. Allocation of the book budget for collection development enabled NSTIC to acquire special materials such as NTIS technical reports, standards, and other research items to cope with the changes in KISR programmes and emphasis on contract research as well as the increase in cost of materials, inflation, jobber services, and air freight. Accordingly, the centre has been able to develop a core collection of printed and non-printed materials to support the user's need for information resources. (See reference 3.)

Staffing

An important element in developing a successful information centre is qualified manpower of professionals and paraprofessionals. Thus, staffing was a crucial issue for NSTIC, especially where international standards not only require a professional degree in library and information sciences, but also knowledge and specialization in certain scientific and technical areas. It was difficult for NSTIC to meet these standards and recruit professionals locally at the beginning, with a stagnant library profession and substandard library education.

NSTIC started in 1976 to recruit highly qualified librarians and information specialists from developed countries. At the same time, it also established qualification guidelines and minimum standards required for the development of professional and para-professional staff. In fiscal year 1983/1984, NSTIC had a total staff of 40, of whom 16 were professionals, 21 para-professionals, and 3 support service staff.[2]

Library Resources and Organization of Materials

By the end of fiscal year 1983/1984, NSTIC had a total collection of 45,000 book titles, 1,800 current periodical titles (including indexes and abstracts), a reference collection, and a collection of 300,000 technical reports on microfiche from NTIS covering 35 subjects of interest. Comprehensive collections have been developed in the areas of earth sciences, ecology, energy, agriculture, engineering, life sciences, marine biology, materials sciences, petroleum, and petrochemicals. Strong collections were also developed in economics, business administration, industry, computers, and information sciences.

Selection criteria emphasized the acquisition of scholarly and research materials to ensure quality, relevance, and interest to KISR. The use of subject profiles and approval plans provided adequate coverage of subject areas and facilitated the acquisition process. NSTIC has also maintained specialized collections for standards, specifications, and patents, including the indexing services of INPADOC and Darwent. It also retains on microfilm back files of selected periodical titles, and a limited number of audio-visual materials.

The Arabic collection of books, periodicals, and reports is relatively small in comparison with collections in English. This is due to the meagre production of material in Arabic in science and technology, and the absence of standard bibliographic tools for evaluation and selection of Arabic materials.

The organization of library collections follows international standards, mainly AACRII (Anglo-American Cataloging Rules 2) for cataloging, and Library of Congress schemes for classification and subject headings. Traditional library card catalogs have been phased out since 1980 and converted to an on-line catalog and a COM (Computer Output On Microfiche) catalog using LC-MARC (Machine Readable Cataloging) standards. These catalogs are accessible on microfiche to NSTIC users on-line via terminals within KISR. As for organization of the Arabic materials and document collection, NSTIC developed a new system for handling these based on MARC cataloging standards and an Arabic version of STAIRS for on-line storage and retrieval.

Information and User Services

To develop a constituency of information users, NSTIC had to consider several factors. Information services have been constructed around the user and his right to have immediate access to information pertinent to his needs. This required the development of user profiles to identify and synthesize their research interests so that specialized services such as current awareness, and selective dissemination of information (SDI) services could be provided.

To enhance service capabilities, on-line access to international data bases such as Lockheed (Dialog), SDS (Orbit), BRS, INPADOC, and EURONET were introduced using regular telephone lines and intelligent terminals. Other non-bibliographic data bases are currently under consideration. This service has been upgraded, with a telecommunication node via Italcable in Rome being established with the support of Kuwait PTT. This allowed the information staff to gain new experience in on-line search techniques, thus increasing and enhancing on-line services both for KISR users and for users in academia, government, business and industrial institutions in the country.

Conventional services such as manual search, reference, referral, circulation, interlibrary loan, and photocopying service are also provided. Specialized Services are also provided and maintained for a collection on Kuwait, marine sciences, subject bibliographies, information bulletins, and seminars for training of users. (See reference 5.)

Computer Applications

Computer applications for NSTIC in-house functions were developed in two stages. The first, in 1976, when the Government Computer Centre of the Ministry of Planning, with an IBM 360, was used for simple applications in developing a periodicals list in a batchmode environment. This modest list of 400 periodical titles started a series of bibliographic control programmes for identifying and locating scientific and technical information resources in the country.

The second stage started in 1981 when KISR acquired an IBM 4341 that allowed NSTIC to develop its own bibliographic control programmes in an on-line real-time mode. These programmes included the design, development, and maintenance of bibliographic data bases for a Union List of Periodicals on the national and regional levels, an on-line book catalog for NSTIC, and a National Union Book Catalog for special libraries in Kuwait. The Regional Union List of Scientific and Technical Periodicals lists over 9,000 titles available in selected special and university libraries in Kuwait, Iraq, Saudi Arabia, United Arab Emirates, and Bahrain. The list is updated and published biannually and has proved to be a useful bibliographic tool for future co-operation among libraries in the area. Another data base was also developed for the Arabic periodicals available in special libraries in Kuwait, and is updated annually. A National Book Catalog was developed in 1977 for non-Arabic material and produced in 1980, and a data base of over 65,000 book titles in science and technology was built. However, problems of standardization of bibliographic entries had to be resolved first, before updating this union catalog. (See reference 6.)

NSTIC has been also active in developing other data bases for circulation, to control materials checked out on loan, and to generate overdue notices. The data base for key-word out-of-context (KWOC) indexes are used for verification and identification of items in process and the production of COM (Computer Output on Microfiche) catalogs. The Centre is also adopting an integrated data base approach in NSTIC automation programmes where a centralized collection of interrelated data can be used for one or more applications. The conversion of cataloging records to full MARC format produced a data base catalog accessible on-line and also in COM format, which replaced the traditional card catalog.

The IBM Storage and Information Retrieval System/Conversational Monitor System (STAIRS/CMS) has also been applied in developing bibliographic data bases, including the Arabic collection. Other computer applications are under way for the acquisitions function, NSTIC management, and the information network for special libraries in Kuwait.

Kuwait Information Centre (KIC)

Since NSTIC has been acting as a depository library for government documents, the Centre's activities in the last two years have been directed toward developing a viable collection on Kuwait, both in Arabic and English. Procedures for acquisition of documents from government agencies and cataloging and organization of materials were established. The special collection developed on Kuwait has been organized into a data base using LC-MARC standards to create an Arabic MARC and the Arabic version of STAIRS. New facilities have been designated for KIC, where information services are provided to the users of this specialized material.

Training

Training has been a major objective of the centre and the development of trained professionals and para-professional staff is a continuous process in NSTIC. The recruiting of senior professional staff of librarians and information specialists provides the centre with the ability to perform on-the-job training for junior staff and para-professionals. A basic training programme has been developed for young Kuwaiti graduates to enhance their knowledge of English and typing skills before pursuing further education in accredited graduate schools of library and information sciences abroad. KISR conducted two training seminars, in 1978 and 1980, to promote and enhance technical capabilities and know-how of librarians from special libraries in Kuwait and the Gulf States. (See reference 7.) In-house workshops and seminars in specific library functions have also been organized to enhance staff capabilities and performance.

Problems

NSTIC has proved its ability to meet the needs of KISR for scientific and technical information to support its research programmes. The centre was able to fulfil partially the national needs for information services. Over 40% of NSTIC's total services in 1983/1984 were provided to government agencies, academia, business and industrial institutions in the country. Kuwait University alone accounted for 30 percent of outside services. However, services to national institutions are limited by certain budget constraints, the continuous increase in the cost of search materials, and limitations on NSTIC staff growth. These hinder NSTIC from developing a comprehensive information service programme to meet national needs. To rectify this situation, outside fund-

ing from national institutions or other government sources is being solicited to augment the NSTIC annual budget, which is totally funded by KISR.

There are also important factors affecting NSTIC's role on the national level, such as the absence of a national information policy to identify and regulate library and information services and ensure the allocation of the funds needed for developing a modern national library system. Furthermore, the absence of library and depository laws is a major factor hindering NSTIC from developing the full depository library in which public and private institutions are legally required to deposit their publications.

National manpower development is another critical issue, not only for NSTIC but also for other institutions in the country. The library profession has not achieved any significant prominence in the country. This makes it difficult to attract young nationals to follow a career in the library and information fields. This problem is receiving more attention now, as the value of information as a resource of crucial importance in socio-economic development is realized. Apart from upgrading working conditions, salaries, social status, and career development prospects, the upgrading of educational standards and facilities is necessary. This will produce a new generation of information specialists able to cope with new trends in library and information technology. Kuwait University and other educational establishments are actively developing appropriate plans in this direction.

It should also be noted that user and institutional needs for information on the national level have not been in any organized form, except for the limited information services provided by NSTIC to national institutions and individual users on demand. Lack of a national information policy to identify users and uses of information and to specify the present and future information needs of the country has been a major factor in downgrading the value of information, and consequently affecting the development of modern, organized libraries and information centres within the existing national institutions.

Other problems of significance are related to technical and organizational matters, which have a serious impact on interlibrary co-operation on the national level. Although NSTIC has followed international standards in the organization and processing of library resources, as mentioned earlier, most other libraries in Kuwait and the Gulf region still follow systems of their own. Adoption of unified international standards for handling, organization and processing of information resources, while much needed, will naturally be difficult and costly and will meet with considerable opposition.

While the problem of organizing non-Arabic materials can be resolved by accepting and implementing international standards, the real challenge is in the organization and processing of Arabic materials, in which most libraries are using their own in-house systems and cataloging practices. NSTIC attempted to tackle this problem when the centre developed an on-line catalog for its Arabic collection using LC-MARC cataloging standards, and LC classification and subject headings. Computer applications in organized and processing Arabic materials require co-operation and collaboration of Arab university libraries, special libraries, information and documentation centres, and ALECSO (The Arab League Educational, Cultural and Scientific Organization) in developing and adopting on-line cataloging standards compatible with the international standards applied, and translating into Arabic the LC subject headings list and LC classification schemes, especially the schemes of science and technology and the social sciences. These tools for organizing library materials are essential for specialized and academic libraries.

Finally, co-operation among libraries in Kuwait has heretofore been non-existent, or pursued only on a personal basis. Formal co-operation needs to be established and institutionalized, especially among institutions that share common interests in scientific and technological areas. This avoids duplication of materials, overlapping of activities, and waste of resources. Co-operation can be achieved by developing interlibrary programmes and the active participation and collaboration of libraries in adopting unified library standards and developing an integrated interlibrary system to promote and augment information services in the country.

Special Library Information Network: Future Prospects

As a national information centre and the main focal point for special libraries in Kuwait, the centre is expected to promote the development of a network of special libraries for exchange and dissemination of scientific and technical information.

To achieve this objective, a survey and analysis study was conducted last year to characterize the prevailing conditions and review practices of 16 special libraries sharing a common interest in scientific and technological fields. The study was also intended to evaluate and analyze resources, functions, and activities of the libraries selected to collect pertinent information on equipment, facilities, and services provided.

The questionnaire method was used to provide descriptive and statistical data on the libraries selected. Field interviews and personal observations were also conducted. A data file was compiled on the libraries selected and used for data analysis. The final report of the survey findings will be published soon. It will include statistical and factual information on library characteristics, strengths and weaknesses, specific issues, and problems relating to practices developed. The report will also address itself to outlining a practical approach to meeting user needs, taking into consideration the new concept of interlibrary co-operation and networking based on the computer and telecommunication technologies available.

Conclusion

In conclusion, the development of NSTIC as an organization for information systems and services has been a modest example of providing special librarianship and information services in a developing country. The triple function of the centre as an information arm for KISR, a national library for science and technology, and a depository library for government documents has proved to be a valid concept for Kuwait, especially in the absence of a national library. The commitment of management and staff and the allocation of adequate funding have been major factors in creating a stable organization, good collections, effective services, and a host of bibliographic data bases.

The dynamics of future growth of NSTIC as a national focal point for scientific and technological information in

Kuwait depend on the support and funding of a national information service programme to develop an interlibrary cooperative and an information network of special libraries in the country.

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Notes

[1] KD = Kuwait dinar—Editor.

[2] See section on training, below.

Scientific and Technological Information Experiences and Activities in Ghana: Problems and Future Prospects

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Abstract

The role of science and technology and of scientific and technological information for development has continued to gain increasing recognition in Ghana. However, this recognition awareness is yet to be demonstrated in concrete and practical terms. In spite of this, a modest infrastructure exists for the development of a national scientific and technological information system. Efforts towards a national scientific and technological information system have been plagued by a host of problems, which include the absence of a policy, financial constraints, inadequate manpower, and lack of facilities and other material resources.

This paper discusses attempts made to develop a national scientific and technological information policy and its relationship with a national science and technology policy, problems relating to material resources and facilities, and actions taken for the provision of scientific and technological information. It also discusses the problem of users and their information needs, and concludes with some suggestions on how the situation can be improved, in the light of proposals towards the establishment of a global network of scientific and technological information.

Background

The idea of scientific and technological information for development gained some footing in Ghana with the establishment of the National Research Council (NRC) in 1959. The NRC, now known as the Council for Scientific and Industrial Research (CSIR), was set up in the realization of the vital role that science and technology can play in national development. Theretofore, there existed several research institutions under the erstwhile West African Research Organization, from which Ghana withdrew in order to carry out and better co-ordinate scientific research of direct relevance to her development needs.

Accordingly, from its inception as the NRC, the CSIR has had the objective of undertaking and co-ordinating scientific and technical research in Ghana. Its principal statutory functions include advising government on scientific and technical advances likely to be of importance to national development, and collaboration in the collection, publication, and dissemination of the results of scientific research and other useful information to research scientists, development planners, and other workers in the various sectors of national development.

This resulted in the creation in 1964 of the Central Reference and Research Library (CRRL), which assumed responsibility for co-ordinating library and scientific and technical information activities within the CSIR (which at present has eight research institutes) and also, for developing a national scientific and technological documentation centre. Over the years, the CSIR itself, and the CRRL as well, have undergone a series of administrative changes and reorganizations in the desire to find better ways of achieving their objectives. As a result, considerable knowledge has been gained and a better appreciation obtained of the main problems and constraints that impede the rapid attainment of an efficient and effective system of providing scientific and technological information.

From the developments so far, there now exists a modest but viable infrastructure to support the various activities and programmes to be undertaken in developing a national scientific and technical information network.

Infrastructure

Ghana's infrastructure for science and technology and for science and technology information are based on the many institutions, the manpower development facilities, and the other facilities which have developed over the years. With the realization that the existing S&T infrastructure cannot bear the weight of sustained economic growth, there is currently a major move by the PNDC government towards reviewing past science and technology policies and consolidating them. Since the creation of the CSIR, and since the recent formation of a Ministry of Industry, Science, and Technology, there has been a considerable increase in the level of awareness of the role of science and technology and S&T information in national development. Successive national development plans always made reference, albeit in passing, to the need for a national science policy. The 1980 National Development Plan, which had comprehensive coverage of science and technology, not only identified the various institutions constituting the main scientific and technological base for Ghana, but also identified the main problems and constraints and set goals and targets for the plan period. Although the plan was hardly implemented before the change of government in 1981, it now provides the basis for the current review

exercise being carried out by the PNDC government, as part of the national economic recovery programme.

Efforts towards the formulation of a national science and technology plan have been promoted by the CSIR, in its interaction with various other institutions apart from its 10 research institutes and units. These institutes and units of the CSIR cover agriculture, industry, food, water resources, and building and road research. Other research and development institutions, not directly under the CSIR or in the three universities or other institutions of higher and technical education, also exist. There are also several financial and development banking institutions, a national standards organization, and recently, the nucleus of a centre for technology transfer at the CSIR.

Computer and telecommunication facilities and services have continued to improve and to gain in use, both for governmental administration and in the private sector. An earth-satellite station provides external telephone and telex facilities, with prospects for eventual packet switching and possible on-line communication with external data bases. Microwave links will be completed this year to facilitate direct telephone linkages with other West African countries and also to improve local networks.

With special reference to the S&T information infrastructure, various actions over the years have resulted in a draft national plan which is currently in the process of being integrated into the economic recovery programme.

The institutional organization for S&T information consists mainly of the eight institute libraries of the CSIR which form one network; the libraries of the three universities and their small departmental collections; various government department libraries, including these of the Ministry of Agriculture, the Geological Survey department, the Volta River Authority, and the Ghana Standards Board; and the libraries of the National Investment Bank, the Cocoa Research Institute of the Cocoa Marketing Board, and the Forest Products Research Institute of the Forestry Commission.

With regard to manpower development, there is a Department of Library and Archival Studies at the University of Ghana. Training is offered at the certificate, non-graduate diploma, graduate diploma, and master's levels. However, the output in recent years has dwindled and the teaching staff has also been reduced considerably as a result of the mass exodus to neighbouring countries, due mainly to the present economic situation. Opportunity for training overseas is offered mainly by the British Council; offers by United Nations and international agencies hardly exist. The general manpower supply has also been reduced during the last six years, mainly because of the economic situation of the country. This trend will certainly be reversed as soon as the economic situation improves. As regards the quality of professionals, there is a general lack of specialists in information science, and the facilities offered by the Department of Library and Archival Studies are rather limited.

With regard to other facilities and equipment, a new building to house the national focal point for scientific and technological information is nearing completion, but external support will still be needed for internal fittings and for items of equipment like photocopiers, microfilm equipment, and computer facilities.

A survey carried out in 1976 of existing facilities for a national S&T information system (now rather outdated but still valid) revealed that there exists a modest infrastructure, which consists largely of libraries that are traditional in outlook. The survey further revealed that facilities for acquisition, organization, storage, retrieval, and dissemination of scientific and technical information, as well as the manpower and services provided, were rather inadequate. However, no detailed study has yet been undertaken of the needs of the various user categories and of the use made of the resources available, to determine the quality of service. The survey did reveal that the literature resources, especially with regard to journals and the abstracting and indexing of periodicals, was reasonable, although there was considerable duplication.

Activities and Services

Since its inception, the CRRL has pursued the objective of co-ordinating library and information activities within the CSIR library network, on the one hand, and also providing the necessary leadership in the development of a national S&T information system. It has over the years developed a sizeable collection of core scientific and technical journals and reference literature to complement the holdings of institute libraries. The collection consists mainly of abstracting and indexing journals as well as reports and reference monographs. With its legal backing as one of the national repositories for locally published material, it also tries to collect all "grey literature" in science and technology.

Some of the services it has provided, with varying degrees of success, include photocopying, arranging translations, interlibrary loans, exchanges with external libraries, literature searches, and the compilation of comprehensive bibliographies. With the recent creation of a national committee for patents, it will also act as the repository for foreign patents.

A publications and documentation unit, recently set up, undertakes the publication of several reports and journals, as well as directories of research projects and of high-level manpower. However, *Ghana Science Abstracts*, which covers formally published as well as grey literature, has run into difficulties in recent years.

Various activities of the CRRL as the national focal point for scientific and technological information have resulted in the formulation of a draft national scientific and technological information policy and proposals for a national network for scientific and technological information service. Following a Workshop on the Pooling of Resources, including information, in 1971, a series of developments have taken place. A national survey of existing facilities was carried out in 1976. This was followed by the publication of an action report on proposals for a national scientific and technological information system, jointly produced by the CSIR, the IDRC, and the United States National Academy of Sciences. This resulted in a request to IDRC for technical assistance. For various reasons, there was no follow-up on the request until a visit in August 1984 by an expert from UNCSTD. This visit resulted in the provision of some basic information to UNCSTD on the existing infrastructure for a national scientific and technological information system.

In the meantime, developments at the local level have led to the reconstitution of the National Committee for UNISIST into a National Committee on Scientific and Technological Information. This reconstitution was mainly an enlargement of the former committee to include as many sectors of the national economy as possible. The new national committee will undertake a further detailed study of the proposals made

for a national scientific and technological information system for transmission to UNCSTD, with the hope for some form of technical assistance, either from United Nations sources or from other international agencies.

Problems and Constraints

The problems and constraints in Ghana's effort to develop a national scientific and technological information system are inextricably related to social, cultural, economic, and political factors. However, the immediate problems arise principally from the shortage of suitably qualified staff, and also from improper planning and poor management practice. It is one's strong conviction that even in the face of the overriding social, economic, and political issues, carefully designed plans and programmes, with very clear and realistic goals and objectives, well costed and adhering to clearly specified time frames, will withstand political upheavals, and will continue to gain support and approval of top management and policy makers with every change of government.

The lack of a national policy has always remained a major stumbling block. This is mainly due to weak leadership, coupled with the lack of clearly defined priorities which result in a tendency to take *ad hoc* measures to solve crises, with the result that resources are thinly spread. It also arises because of the desire by various organizations and institutions to show results in their specific areas and thus justify their existence, which leads to an unco-operative attitude on the part of some institutions toward projects which may appear to be rather special and open-ended, or which might entail extra expenditure for which their limited budgets have no provision. The development and maintenance of a national union catalog of scientific monographs, and contributions toward the regular publication of a national bibliography of scientific and technological literature in the form of the *Ghana Science Abstracts*, are typical examples of the parochial attitude of most libraries.

Another major problem is the lack of financing, which is a general national problem. As a result, there tends to be a lack of continuous and sustained financial support for ongoing projects. A case in point here is the still uncompleted building of the national focal point—a project which has so far taken ten years. Problems of foreign exchange also seriously affect the acquisition of foreign literature and equipment. Much of the blame here can be traced to the absence of co-operative measures and the sharing of resources which has resulted in several duplications of journal subscriptions.

The question of adequacy of manpower—a perennial problem—has in recent years been aggravated by the national economic crisis, which has resulted in a mass exodus of professional librarians to seek greener pastures elsewhere. As a result of this "braindrain", the Department of Library and Archival Studies has suffered considerable losses in teaching staff in recent years. The quality of professional training also poses a problem in that so far no attempt has been made to relate library and information services and practice to the rather underutilized computer facilities, which continue to increase in the country. The awareness of the potential benefits of computerization is nonetheless gaining ground, although fears expressed in certain quarters suggest that available resources and services may not warrant mechanization at this stage. This fear is untenable if the situation is viewed in broader national terms.

As a consequence of the limited supply of manpower, no user studies have been undertaken and hence there is no yardstick for measuring the effectiveness of services to the various user categories. In spite of this, experience has revealed user needs which are peculiar to certain categories. Whereas the information requirements of the research and development user category are fairly well defined, and the main constraints are known to be the lack of knowledge of information sources and of copies of actual documents, the information needs of policy and decision makers, constitute a major problem area, along with those of the illiterate majority, who are mostly engaged in farming and other rural activities. For these categories, it is not so much the dearth of information that is the problem as the form in which it is presented to them. The issue of repackaging scientific and technical information is one which entails considerable investment in terms of manpower and facilities for reprography.

With regard to the rural population, the problems arise because by tradition the society is not a reading culture but an oral one. Consequently, communication of information assumes various forms, including actual demonstration through extension services, and through other organs of community health and development, as well as mass literacy campaigns.

One user category of major concern to the CSIR has been that of the industrial and small business enterprise sector. Apart from the large multinational concerns, which largely depend on the research results of their foreign research and development institutions, most of the business enterprises in Ghana are largely based on turnkey projects which hardly need any local scientific and technical information for their survival. Their main need is for adequate raw material, which in many cases is imported, and for machine parts. However, those who require local raw material depend mainly on agricultural agencies and are little concerned themselves with the production of such raw material. In spite of this, there is a growing industrial sector consisting of entrepreneurs who would gladly have any information that would enable them to run profitable ventures. Their main problem appears to be not knowing where to obtain the information they need, or not being aware that they need information.

Although the various institutes of the CSIR have produced research results which could promote the development of such industries, most of the results still require further testing on a pilot scale. Facilities for pilot plants are virtually nonexistent. Furthermore, the development finance institutions which could support such projects tend to fix their attention more on projects which are already known to be economically viable. This is largely because these institutions do not themselves have the requisite technical manpower—scientists, engineers, and chemists—and are staffed predominantly by economists and accountants. A similar situation applies in certain key policy-making government Ministries like those of Economic Planning and Industry, and Science and Technology. In view of the general shortage of such technical personnel, it seems that the only way to surround the problem is to establish closer linkages with the CSIR and other research institutions which have the heaviest concentration of technical manpower.

The issue of technology transfer has not been given sufficient attention; so far, attempts in this area have remained rather unco-ordinated. The few institutions which provide

services along this line include the Technology Transfer Centre, Technoserve, and the Midas Project; these are supported by the limited consultancy services provided by some of the CSIR institutes. With the establishment of a Project Analysis Group (PAG) and a Centre for Technology Transfer at the CSIR, it is hoped that the necessary direction and greater impetus will be forthcoming.

Future Plans and Prospects

As already mentioned, there is ample and fast-growing awareness of the important role of scientific and technological information for development in Ghana. With the growing political stability currently prevailing in the country, and from the broad principles of the national economic recovery programme, coupled with growing support from international agencies like the World Bank as well as from many bilateral donor countries and multinational institutions, there is considerable hope that Ghana will stem the present economic tide. On the local front, talks have been held in Accra between the government and the UNDP in Ghana on the national economic recovery programme, and a series of discussions involving practically all sectors of development are currently taking place. As stated earlier, a draft national plan for scientific and technical information and issues involving a national policy for science and technology as related to the overall national development plan are in the process of integration.

Briefly, the draft plan for scientific and technological information seeks to establish a national network for the provision of scientific and technological information for development. The network proposed consists mainly of a national focal point, with sectoral nodes for agriculture, industry, rural development, energy, health and environment, geology, mining and metallurgy, construction and engineering, transport and communication, and water resources. These are the main sectors of the national development plan.

The principal objective of each sectoral node is to coordinate activities and services, and to develop or further strengthen those within each sector, paying particular attention to joint programmes in development of collections, especially of materials produced locally within the sector. Other activities of the sectoral nodes include document delivery through loans and photocopies, dissemination by the provision of literature searches, special bibliographies, referral services, and the preparation of extension literature for use in each sector.

The national focal point will have the overall objective of developing and maintaining national standards of practice; undertaking surveys and studies; developing and maintaining national union lists of periodicals and union catalogs of scientific and technical monographs and reports, registers, and directories of ongoing research and manpower; and acting as a national referral centre. It will also establish and maintain links with local, regional and international information systems, as well as other external information systems, and will serve as the main link with the proposed global network.

An important aspect of the plan is to complete the new building to house the national focal point. In this connexion, external assistance is needed for the provision of internal fittings, items of equipment like photocopiers, a microfilm camera, readers and reader/printers, bindery equipment, an offset press, and a computer facility. Assistance is also sought for manpower training for varying periods. The plan extends over a five-year period.

Relations with Global Network

A very important feature of the plan is the emphasis on developing an infrastructure through which maximum benefit can be derived from external sources. To this end, considerable effort has been made to involve as many sectors as possible, with the aim of determining priorities in information needs. Particular attention will be paid to developments in telecommunication facilities and the potential for possible on-line communication with external data bases.

Suggestions

In the light of proposals leading to the establishment of a global network for the benefit of developing countries, and of experiences in the Ghanaian situation, the following suggestions are offered, particularly because Ghana's problems and constraints may also be relevant in other developing countries.

1. Programmes for technical assistance to developing countries should as far as possible be supported with a relevant information component, which would result in the development or strengthening of local scientific and technological information facilities and create local capability for obtaining appropriate information on a continuing basis from known sources.

2. New methods should be explored of developing political action aimed at sensitizing the national governments of developing countries, in order to develop their scientific and technological information plans. In this connexion, the advantage which an expert from a United Nations or other international agency enjoys as compared with a local expert in sensitizing policy and decision makers in the latter's own country is considerable, and needs to be borne in mind. Consequently, such agencies can make quite a significant impact in this direction.

3. With regard to Ghana's peculiar circumstances, and for the benefit of other developing countries in a similar situation, a working model for scientific and technological information should be developed on the basis of plans so far drawn, and adapted for other developing countries.

4. A system of scholarship training awards should be established (not short courses only) as an integral part of the proposed international network.

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Use of On-line Data Bases by Developing Countries Problems and Prospects: The Case of Mexico

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Background

The use of on-line bibliographic data bases is provided in Mexico through SECOBI (Servicio de Consulta a Bancos de Informacion—Consultation Service to Information Banks), a service operated by CONACYT (National Council for Science and Technology), since 1976.

CONACYT is an agency of the Mexican Government, responsible for the development of science and technology in the country. The law that created the institution in 1971 assigns to the Council, among other responsibilities, that of creating a national information and documentation service.

The main motivations for the initiating of the service, came from the need to develop a national information system for science and technology. (See references 1 and 2.) The activities were triggered by several visits to different countries in 1974-1975, and by studying some experiences developed in international organizations (reference 3). Some commercial experiences were also taken into account (references 4 and 5).

Among the objectives foreseen at the creation of SECOBI were the following:

—providing greater facilities to access international information;
—developing a fast and effective service;
—generating local experience in modern technologies;
—establishing the basis for development of local data bases;
—exploring possibilities of avoiding excessive dependency on foreign sources;
—promoting the development of the national information system for science and technology; and
—offering information support to the scientific and technological community at affordable prices.

These objectives, with some adjustments in priorities, could still be considered in effect at the present time.

Situation in 1975

The first discussions for establishing an on-line service in Mexico faced various problems and differing points of view.

On one side were the technology enthusiasts, arguing—usually without having a clear understanding of the issues—that this technology could solve the information and documentation problems of the country. These were generally technical specialists.

A different view was held by many librarians and documentalists, who had very limited understanding of the technology and were worried about the difficulty of learning new techniques and about the possibility of losing their jobs.

A more rational opinion was held by still others who felt that this was a good opportunity for the country to enter a new technological field, acquire experience, and provide additional services.

Some arguments related to the priorities in developing a national information system. Many people felt that in a country such as Mexico, first priority should go to the development of collections to education, and to training, and to other traditional activities. These arguments caused some concern and were duly considered; but it became clear that it would be possible to create SECOBI without interfering significantly with more conventional activities.

Other important problems in developing SECOBI were the legal matters involved in the organization of the telecommunications facilities. A presidential decree of 1972 (reference 7) defines public data transmission services as an exclusive monopoly of the Ministry of Transportation and Communications (SCT). This raised several questions.

The Ministry of Communications, at that time, did not have the necessary facilities for packet-switching data transmission. Furthermore this was a new technology for telecommunications specialists, and they were not willing to make policy decisions on such issues without a deeper knowledge of the long-term implications.

A supplementary problem derived from the fact that SCT was applying to data transmission services some of the policies and concepts from more traditional services, such as telex. This included regulations against the use of dial-up telephone lines.

This issue was finally settled on a temporary basis, through an agreement between SCT and CONACYT. This became possible through the appointment of CONACYT as an agent acting on behalf of the Ministry on the ground that the Ministry did not have the necessary facilities at the time. Also taken into account was the non-commercial nature of the proposed service, and its relevance in the support of scientific and technological activities of the country.

The training aspects also represented an important problem to be tackled. There was no one available with even

minor experience in on-line searching. The vendors were too distant, in another country, and the most knowledgeable people had only seen demonstrations. Therefore, for the first several months, learning had to be achieved by trial and error, through telephone consultation, and—when the mail finally delivered them—by reading manuals. Some training courses by vendors were organized after the initial tests, to supplement the training of local searchers and trainers.

After getting acquainted with the systems and gaining some experience, promotion and training for users were considered.

However, great effort and a long period of time were required to convince the most prestigious libraries to subscribe to the service. The organizations most readily interested were usually not libraries but research centres, new and specialized information centres, government organizations, and private enterprises.

Also necessary was the acquisition of terminals and of a node for an efficient connection to TYMNET (the only convenient network at that time). This imposed a necessary delay, and for several months forced the very first users to operate through long distance calls to the network in the United States.

Early in 1976, all the required elements were ready, and the service was formally opened.

Present Status

At the present time, SECOBI covers the most important cities of the country, providing access by researchers, professors, students, professionals, entrepreneurs, government officials, and the general public.

Services

Six main services are provided at this time:

Information retrieval

Aimed at the general public, this is provided by 13 public posts in several parts of the country, operated by searchers from SECOBI's staff. The user is charged for the direct costs, with special discounts for students, professors, and researchers. From January to August 1984, a total of 1983 searches were made under this service, for an average of 248 per month.

Documentation support

This is intended mainly as a supplement to the previous service. At the user's request, the staff will locate, acquire, and deliver a copy of the original document. The user is charged the direct costs. Requests for this service from January to August 1984 came to 981, for a monthly average of 123.

Translation

When requested by the user, documents can be translated into Spanish. This is done by outside translators. The user covers the direct costs. Requests for this service from January to August 1984 totalled 52, averaging 7 per month.

Direct service

This service is designed mainly for medium- to high-volume institutional users. A contract is signed, and the user receives a password to access the data bases. The necessary terminal equipment and MODEM can either be rented from SECOBI or purchased directly by the user. Microcomputers are beginning to be suggested as a good alternative, if the user is going to purchase the equipment.

For this service, the user pays an initial fee that covers manuals, training, and technical support. The operational costs, including telecommunications, search time, and the like, are billed monthly to the user, including the rental for equipment, if provided by SECOBI. A special discount financed by CONACYT is granted to research and educational non-profit institutions. More than 170 terminals are operated under this service.

Support

A continuing support and technical advice service is maintained. This covers maintenance of SECOBI's terminals and MODEM, advice on the selection of equipment, connection problems, strategy formulation, command usage, procedures, data base characteristics, and other problems that a user may find when using the service. These are usually provided without charge, when requested in reasonable volume.

Training

A strong program of courses is regularly conducted, ranging from basic aspects to specialized topics. Most of the courses are billed for at nominal costs, while others are provided at no charge. From January to August 1984, 53 courses were held (7 per month), with an attendance of 429 participants.

A special arrangement is available to support the service offered by the Ministry of Health. In this case, SECOBI's infrastructure is used to provide access to the MEDLINE system, which is operated in Mexico by this Ministry for biomedical users.

The total usage of SECOBI is well over 600 hours of connect time per month. This (the average for 1984) is above the figures for 1983, but below those in 1982. The reduction was due to the economic problems of the country at the end of 1982; but the demand is now resuming its regular growth pattern.

Infrastructure

The technical infrastructure is presently based on the old node connected to TYMNET. This is being replaced by a new node of the public packet-switching network, which has been developed by the Ministry of Communications (TELEPAC) and has recently became operational. This will reduce costs and improve the quality and effectiveness of service, especially to users far from Mexico City.

The legal aspects of using telecommunication facilities have been covered by a new agreement signed between the Ministry and CONACYT last August. The agreement incorporates several important provisions, including easier procedures to access TELEPAC for SECOBI users, through a special contract; connection to the network of the mainframes needed by CONACYT for local data bases; and provisions for a joint effort in the promotion and co-ordination of data base development and use within the country.

CONACYT has a Burroughs 5900 with 2000 MB of disk storage, acquired for administrative purposes. This machine has been connected to the network and is available to SECOBI users under controlled conditions. At this time it is used to access a data base on economic data, developed by the Bank of Mexico (SIEBANXICO), containing more than 15,000 time series, updated weekly.

The human infrastructure of SECOBI is composed of 41 persons—28 at the headquarters and 13 in public service posts. Figure 1 shows the organizational structure of the Direction of Informatic Services, with details of SECOBI's organization.

Most of the technical people have received in-depth training and participate permanently in seminars, courses, demonstrations, and other activities, both as instructors and as participants. However, the training of technical personnel is a never-ending task, which requires more time and resources than are presently available for this purpose.

The data bases are accessed through contracts with nine organizations from four countries (United States, France, United Kingdom, and Mexico). Therefore the user can choose from more than 400 data bases, touching on almost every field of knowledge.

Also available are facilities such as classrooms, teaching materials, reference documents such as thesauri and catalogs, and other supporting elements.

Perspectives

Future projection of the services is being developed under the guidelines established by the National Program for Technological and Scientific Development 1984-1988 (reference 8), a document recently approved by the Government of Mexico. This document includes a program for scientific and technological information, which encompasses the services provided by SECOBI.

In addition to the mandate to provide, expand, and improve the service, a high priority has been established for the development of national information banks. This is particularly important, since it should allow the country to organize its own information and to gain easy access to and better control of the information needed, including that of strategic importance (reference 9). It can be seen as an essential step towards greater self-determination.

Additional benefits to be gained through the availability of local data bases are ease of access, lower costs, savings in foreign currency, and better adaptation of the services to local users. Also it is worth mentioning, a better position in international negotiations and the possibility of regional developments.

As one of the initial steps for the implementation of this strategy, a committee for the development of national information banks has been appointed. More than 25 institutional representatives participated in the plenary sessions, and well known specialists co-operate in the technical work.

The Committee has approved the following recommendations by technical task groups:

—To adopt ISO 2709 as the basis for magnetic tape format; and

—To adapt CCF as the communications format for Mexico (reference 10).

Groups of experts were appointed at the November meeting of the committee, comprising the following subcommittees:

— Priorities and planning
— Promotion
— Training
— Indexing and abstracting
— Cataloging
— Software
— Referral activities
— Terminology

Some of the present activities of the committee are the following:

1. Several courses for data base producers are being planned for 1985, in order to develop the necessary human infrastructure.
2. The translation of CCF into Spanish is under way.
3. Several software guidelines are being developed.
4. A survey of data bases is being designed, to cover activities either existing, under development, or planned.

In addition, several negotiations are under way to develop data bases, or to make them publicly available. Some examples include Mexican patents, trade marks, internationally published Latin-American articles, on-going research in Mexican universities, Mexican journals, a directory of researchers, and several others.

Since available computer capacity is limited, and the service appliers must compete for resources with other appliers, the acquisition of a dedicated machine is seen as an inescapable need in the very immediate future.

New services

One of the most difficult aspects of providing adequate on-line information services in a developing country is access to original documents (reference 11). Therefore, one of the capabilities most needed is that of locating journals within the country.

This problem is being addressed through a Union List of Serials; which is being compiled at present and will be linked to the on-line service, so that after a search locates the relevant documents, the user can find the original document if it is available in a Mexican library.

Another important need (reference 12)—which might be seen as a second step—is the ability to order a copy of a document or to make an interlibrary loan request for it. This is being addressed through a specialized electronic mail system that can keep track of services provided, costs, and pending requests. The authorized users can link to this capability as a continuation of an information retrieval session. This service is scheduled to operate as soon as the necessary computer capacity is guaranteed.

In addition to the facilities for locating journals in participating libraries, it is also important to be able to locate monograph materials. However, such a service would require a Union List of Monographs, which would be extremely expensive to produce. Therefore, this is being planned as part of another system, aimed at facilitating cataloging and processing.

The system will begin with a fairly large collection of bibliographic information from one of the big library systems

already in machine-readable format. The participating libraries will add to this collection and use it for their own cataloging.

Therefore, the Union List of Monographs will grow gradually, providing both cataloging support and information on the availability of materials. The organizational details are under study to assure the widest possible participation and the best possible service.

Another service, which will be developed for pilot demonstration in early 1985, contemplates the use of satellite links for dissemination of information. This project is being developed in co-operation with the Intergovernmental Bureau for Informatics (reference 13), using one-way broadcasting of information; and could provide new ways of supplying information, taking advantage of the capacity of the satellites purchased by the Mexican Government. The possibilities for information exchange among Latin American countries also look very promising.

Conclusions

The development of on-line information services in Mexico has proved both feasible and useful. It has provided the necessary background for the development of better services, and has been instrumental in the creation of local services and data bases.

The implied monetary costs are within the capabilities of most countries, both for the necessary investment in equipment (less than $US50,000 would be needed for a small node and several terminals), and for the the operational expenditures (proportional to the size of the country).

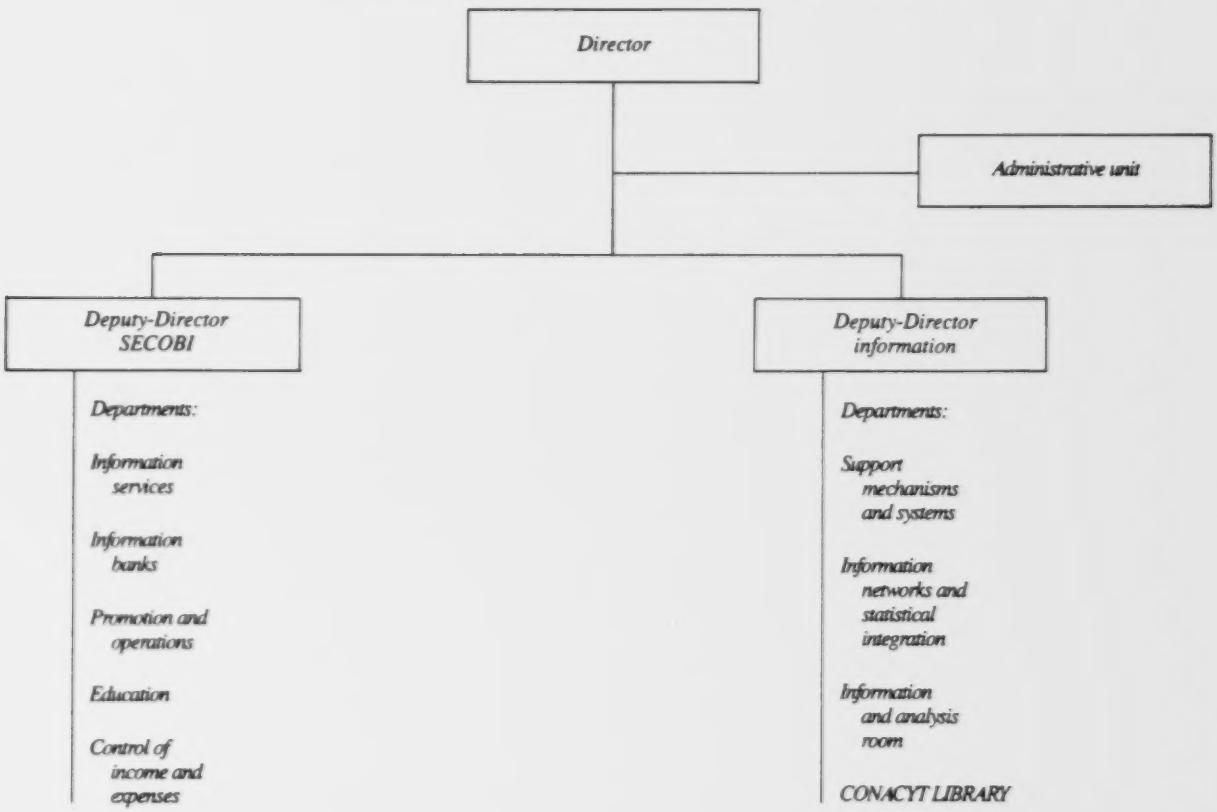
Telecommunication facilities or regulations (reference 14) should be considered a key element. In some countries, existing links may be of insufficient quality or capacity. In other cases, the topology of current channels may be inadequate. Under these circumstances, it could become extremely difficult to set up a service.

It is also important to stress the need for trained specialists and adequate promotion. Also, a mechanism for partial subsidy, under a clear policy, is highly desirable.

Considering the increasing importance of information as a tool for development, and the trends of the information industry in the more developed countries, it can be said that the costs and problems encountered in the implementation and operation of on-line services are a challenge that has to be met by developing countries, if they want to prevent a further widening of the gap between them and the industrialized nations.

FIGURE 1

Organization of the Directorate of Informatic Services



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Status of Scientific and Technological Information and Documentation Services in Africa: Problems and Prospects

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Introduction

Economic growth and modernization in Africa require massive inputs of technology, i.e., science-based know-how. Science and technology are considered by many African countries as a panacea for most of the social and economic problems besetting them. For example, the productivity of many African countries and the income-earning opportunities associated with it depend crucially on the identification and generation of improved technologies in the production process. High priority is therefore being attached to scientific development on the use of technology for social and economic development.

In an effort to strengthen the capacity of African countries in science and technology, great emphasis is being placed on the formulation and implementation of national policies. Such policies should be designed to support the developmental objectives of African countries and must be closely integrated with overall economic and developmental policies and programmes. Scientific policies need to be geared to the advancement of scientific knowledge and development of the scientific infrastructure necessary for technical education and basic research that are consistent with the needs of each economy.

Technological policies, on the other hand, relate more to the application of processes and techniques in various sectors of production and services, and to the development of production and technological capability at various levels. Both, however, are closely interlinked and constitute an essential element of growth strategy aimed at achieving rapid scientific and technological development and self-reliance. Such self-reliance should be conceived in terms of creating the capability necessary for assessing technological requirements in various sectors and for selecting, utilizing, and developing suitable processes and techniques, both indigenous and foreign, as may be appropriate to national needs. It is also necessary that effective parity be achieved with the developed countries in the intricacies of technology trade, acquisition, and absorption, and in the adaptation and development of foreign and indigenous technologies. For Africa to effectively fulfil these aims, up-to-date scientific and technological information is required. For Africa to get the up-to-date information, it needs proper systems of information processing, storage, and dissemination; such systems must be established in Africa.

Problems of Science and Technology Information and Documentation Services in Africa

In Africa today, scientific and technological information and documentation services are for various reasons not well developed, although scientific and technological information may be obtained in libraries scattered throughout many countries of Africa. These are problems in several principal areas.

Co-ordination of service

The lack of co-ordination of scientific information services in Africa, hampers Africa's participation in various international information programmes, e.g., the International Information System for the Agricultural Sciences and Technology (AGRIS) and the International Nuclear Information System (INIS). Co-ordination of these services could improve the related infrastructure at a broad level and thus help to create the scientific, technological, organizational and staff bases for efficient national information networks, and to ensure effective involvement in international projects, especially international information systems.

Sharing of resources

In Africa today, information related to science and technology is not formally exchanged at a regional level. For example, in the Eastern African community, scientific information was formerly shared among institutions of the three countries. Presently each country is going it alone, and no sharing of information is taking place except via "old boy" contacts.

One notes that the development of international co-operation and the establishment of regional information systems are characteristic features of the present stage of development of information services. In addition, there is a rapid increase in the number of specialised materials, the development of electronic data processing and of computer-based indexing and literature searching services, the introduction of selective dissemination of information (SDI) systems, and the like. An efficient regional information system will provide a more solid base for international co-operation in Africa.

National documentation centres

The fact that national scientific documentation centres in Africa are too few, poses a problem in the sharing of resources at the regional level. Some countries in Africa, such as Morocco, Kenya, Zambia, and Nigeria, have already established scientific documentation centres. Others are in the planning stages. However, in some African countries, individual institutions have established scientific documentation centres, e.g., the Botswana Technology Centre in Botswana, the Industrial Regional Organization in Kenya, and the Tanzanian TISCO. With the awareness of the importance of scientific documentation centres among the decision makers of the countries of Africa, one hopes that many such documentation centres will be established.

Participation in international activities

Most countries of Africa do not participate in international information system programmes. Co-operation with international organizations working on data and information services may significantly help develop the national scientific information services of the African countries.

Information and library training

Lack of trained personnel to staff the existing scientific information and documentation centres in Africa is one of the stumbling blocks in the development of scientific information and documentation services in Africa. The type of training offered by many institutions in Africa is at the diploma and certificate level in the field of library studies. No formal courses in information and documentation are offered in the schools which offer library studies programmes. However, schools to offer courses in information science at the postgraduate level are being established in Ibadan, Nigeria, and at the University of Addis Ababa, Ethiopia.

Skilled manpower

Local shortages of specialized manpower and training facilities are particularly striking obstacles to the rapid development and effectiveness of scientific information services in the countries of Africa. This situation is greatly affected by the general absence of a systematic plan for organized training of information personnel, and the rather low status given by governments in Africa to librarianship. At present, in some countries of Africa, information services remain understaffed and highly dependent on expatriate personnel. It appears that lack of funds prevents the governments from giving the assistance required in this area.

Bibliographic control

It appears that a lot of scientific information has been produced about African countries, but most of this information is not well documented. Many African countries have legal deposit laws requiring that government documents and publications by the country's citizens, or publications about the country from foreign sources be deposited in a national library or national archives, or both. This policy is valuable and necessary but is not easily enforced. Furthermore, the national bibliographies produced, in some African countries are sketchy and do not give a clear picture of what exists. To make the situation worse, many countries in Africa do not produce national bibliographies at all. Lack of control of what literature is produced within each country in Africa, and about each country, renders a policy of bibliographic control in Africa ineffective.

Future Prospects

In Africa today there is a rapid growth in the volume of scientific information. This rapid growth is straining the traditional way of handling information. I will at this point make some rough predictions regarding the future developments of scientific information and documentation services.

Computerization in information and documentation work

Generally there is a recognition that the world—or at least the developed nations of the world—may already be involved in an information revolution. In this revolution there is an unprecedented demand for information and an unprecedented use of it, matched by the rapid introduction of modern information-handling techniques with which to manage it, e.g., the establishment of the Pan African Documentation and Information System (PADIS) to take care of development-related information. The emerging recognition that information is a resource, fundamental to human activity, highlights the obligation to make it readily available to the whole community and to each individual, rather than only to institutions or particular groups.

To identify and provide only the appropriate information, or all the relevant information available, is becoming progressively more difficult, certainly more resource-consuming, and frequently impossible. Great changes will be needed in the manner in which scientific information is presented.

Development of regional and national systems

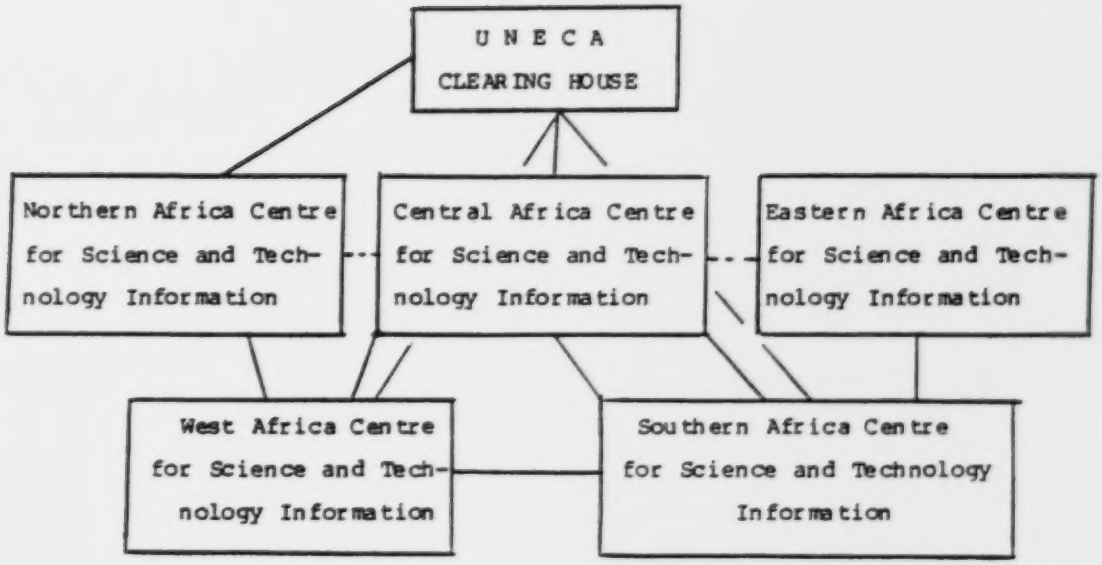
The development of regional co-operation, e.g., the creation of PADIS and the establishment of national documentation systems, are becoming characteristic features of the present stage of development of information and documentation services in Africa. In addition, there is a rapid increase in the number of specialized materials, in the development of electronic data processing and of computer-based indexing and literature-searching services, and in the introduction of selective dissemination of information (SDI) systems. Efficient national information systems may provide solid bases for regional co-operation in science and technology matters in Africa..

Recommendations

Africa today is faced with enormous problems, such as disease, hunger, and lack of shelter. The African countries tend to consider science and technology as a panacea for most of these ills. Many of the countries of Africa have created science and technology councils and made science subjects compulsory in schools. However, despite these efforts Africa still remains backward in using science and technology in such fields and production and marketing. To alleviate some of the problems the African countries need to seriously consider using scientific and technological information.

When one looks at Africa today, one notices distinctive problems in each region. For example, the Sahel countries

Table Proposed Science and Technology Information and Documentation Network in Africa


U N E C A
CLEARING HOUSE
Northern Africa Centre for Science and Technology Information
Central Africa Centre for Science and Technology Information
Eastern Africa Centre for Science and Technology Information
West Africa Centre for Science and Technology Information
Southern Africa Centre for Science and Technology Information

are faced with land degradation problems, the Northern African countries are faced with the problems of desertification over and exploitation of mineral resources, the Eastern African countries are faced with problems related to drought and food production, the Southern African countries are faced with drought problems and with problems related to the management of the environment.

Science and technology information and documentation centres could be set up on subregional basis: one in Botswana or Zimbabwe to serve the Southern African countries, one in Kenya to serve the East African countries; one in Sahel country; one in Northern African country. The focal point of these subregional centres could be situated in the United Nations Economic Commission for Africa headquarters and be run on lines similar to those of the Pan-African Documentation and Information System (PADIS), which supplies development information. Alternatively PADIS could be given more resources for the supply of science and technology information.

My second recommendation is to inventory all active science and technology information and documentation centres in Africa, so as to determine how science and technology information and documentation systems can best be created in Africa and from what points such systems can be coordinated.

In the establishment of national and regional information and documentation centres and systems in Africa, the expectation would be that in future they would both initiate and support the development of scientific and technical information services, so as to keep pace with increasing knowledge and the growing needs of contemporary African societies. We see scientific information and documentation services in Africa carrying out the following functions:

1. Increasing the efficiency of research development and training, thus speeding up innovation as one of the basic prerequisites for an enhanced quality of life;

2. Improving the efficiency and competitiveness of industry and technology, particularly of medium-sized and small concerns, and assisting professional and manual workers, thus contributing to the improvement of working conditions;

3. Supporting planning and decision making by parliaments, governments, and administrative and legal organizations;

4. Providing a better supply of scientific information for individual citizens and social groups, thus improving their co-operation in various areas of social life.

Information on the following, for example, should be supplied by the science and technology centres that I have suggested:

—Increase in agricultural production;
—Protection of crops and animal health;
—Control of population;
—Conservation and improvement of land already under cultivation and the development of new land;
—Checking the urbanization process and improving conditions in the rural areas;
—Water development for irrigation
—Import of technology from the industrialized countries;
—Storage and preservation of agricultural products;
—Nutrition and food technology research;
—Resource and energy development;
—Industrial growth and production; and
—Development of transport and communication.

The science and technology information network being proposed need not necessarily be computerized in the first place. For example, the United Nations could set aside $US5,000 for each country in Africa to compile a list of all science and technology-related materials to help in the planning of such a system. Each country in Africa could be assisted in the compilation of science and technology information using manual tools, and such a list could be sent to the clearinghouse for production of a complete list of science and technology information in Africa. Experience has shown that suggestions for computerization at an early stage scare off the possible participants in such an information system.

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PART FOUR

Problems and Trends

Constraints on the Flow of Scientific and Technological Information: A Review of Issues with Particular Reference to Developing Countries.

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Introduction

The emergence of advanced information systems and the structural change which has taken place in advanced industrialized countries during the post-war period has signalled the coming of the "information society". These events have focused attention on the role which information activities play in modern economic development, and subsequently on the need to create appropriate institutions for the transfer of information. In particular, the dissemination of scientific and technological information[1] is being conceived of as a vital element in promoting the technological change so crucial to economic growth. For this reason, advanced systems for information retrieval utilizing large-scale data bases have been set up recently, primarily for the purpose of serving users on the OECD countries.

Developing countries find themselves in a situation where the importance of information as a resource for their technological development must be recognized, but in which the gap in their access to such information is constantly widening. As one result, this may lead to a new emphasis on support of information activities as a national priority. The urgency of the situation may also encourage decision makers in developing countries to review their current infrastructure for the international as well as the national flow of information. Finally decision makers in developing countries may be encouraged to consider the introduction of information technology on a large scale, since such technology has become the backbone of modern information retrieval.

Ideally, all three actions would do much to improve the situation of developing countries. However, there is a strong tendency to focus attention of the third of these actions—the introduction of new technology—and to neglect the importance of genuine support for information activities and theoretical review of current information flow which is necessary for the successful introduction of new technology.

This paper will address some issues associated with a review of the current situation, namely, the constraints which developing countries face with regard to information flow. Such constraints on the flow of information and its use in the developing countries may have a very serious impact in the long run. In fact, it will be argued here that these constraints may reduce considerably the effectiveness of information retrieval.

A Typology of Constraints

Any information activity may in principle be seen as an attempt to overcome various constraints with regard to the flow of information. For example, the extensive efforts which librarians and information scientists put into indexing, abstracting, cataloging, and various forms of information—retrieval design are clearly valuable in overcoming the current problems of access to information. In the present paper, however, the constraints which originate in the economic and socio-cultural contexts of information systems in the developing countries will be placed in focus. These environmental constraints are not associated with the organization of information as such, but tend to derive from the position which information systems occupy in the global or national political and economic structure, and from the role which information actually plays in development efforts in the third World.

The typology proposed here distinguishes between four basic dimensions of constraints: constraints on **formal** and **informal** flows of information on the one hand[2] and **international** and **national** constraints on the other. These four dimensions must primarily be seen as convenient ways of analyzing the constraints described. It must be kept in mind that many constraints which are felt at one level actually emerge as a result of constraints experienced at another level.

Constraints on Formal Information Flow at the International Level.

In a sense, people in the developing countries may be said to need international sources of information more than anyone else. They are usually equipped with weak scientific and technological infrastructures; and utilizing internationally available information sources can be seen as a useful way to overcome this inherent weakness. Once people from developing countries engage in the international transfer of infor-

[1] The concern of this paper is primarily with scientific and technological information, particularly that directed to scientists, engineers, and technicians in developing countries. This definition of "information" by no means implies disregard of the value of other types of information e.g., economic or political for development purposes.

[2] The specific problem of informal information flow is a crucial but frequently ignored aspect of promoting development.

mation, however, a number of difficulties associated with constraints to the international flow of formal information immediately arise. We can summarize these constraints as follows:

—*Financial:* acquisitions, data base search.

—*Technical:* communications, compatibility.

—*Legal:* patent, copyright.

—*Political:* military and commercial secrets.

—*Cultural:* language, priorities in science and technology.

Financial

There is no doubt that the most critical problem for developing countries that wish to access international sources of information is the high cost of doing so. The price of printed literature has been rapidly increasing over the last few decades, and access to the data base sources which are now available can be immensely expensive, given the high cost of telecommunication linkages. The financial constraints related to acquisition of printed material have become more serious for several reasons. First, the international scientific and technological literature has expanded at a very rapid rate, increasing the financial burden of maintaining current coverage of even the most essential sources of information, e.g., scientific journals and books. Secondly, the cost of paper and printing has itself experienced inflationary pressures.

The access to international data bases or networks has also proven a very expensive affair. Firstly, the cost of a search—especially an interactive search—will usually exceed the economic capabilities of individual researchers. The total cost of such data base searches includes both access fees of various kinds (e.g., subscription rate, hourly rate, on-line or off-line print) and telecommunication costs, which in the case of most developing countries that require intercontinental linkages are prohibitive. The cost of a typical search, say, a half-hour interactive search from Brazil, may amount to almost a third of the average income of a researcher in Brazil, and much more than the average monthly income of a worker. Therefore the majority of searches in public data bases are conducted through institutional subscriptions; and current experiments undertaken with the aid of national or foreign funding must sooner or later face the task of introducing commercial services. With the present cost structure, this seems to be very difficult to achieve.

Technical

The technical constraints are mostly associated with the backward levels of telecommunications technology in developing countries, and the fact that many international communication linkages are designed to serve users in the industrialized countries. Although quite a few developing countries have established one or several linkages with international satellite communications systems, local telecommunication systems are frequently fraught with technical problems. The result is that, at best, there will be only one communications node in the country; and the establishment through this node of a decentralized network for access to international communications is very difficult.

Another constraint is the problem of compatability, which will affect the use of non-specialized terminals (e.g., microcomputers) in international on-line information retrieval. Again, the problems are aggravated by the lack of digitalized networks and packet switching facilities in most developing countries. However, when a centralized node for international communications is set up with specially leased connections to international networks and with special equipment, the problem of compatibility is naturally minimized.

Legal

Most of the scientific and technological information which is generated in the formal, public research and development systems of industrialized countries is freely available to users in developing countries, under the cost structure mentioned above. But a significant portion of the information which is potentially interesting to developing countries is protected by various kinds of legal provisions. One of the systems which offer information under strict conditions regarding ownership is the patents information system. Patents represent a rich source of technical information, but the use of this information is usually circumscribed by the need to enter into a licensing agreement with the owner of the patent.

Similarly, the diffusion of information in developing countries may be limited by copyright provisions. The issue of copyright has become especially significant lately, precisely because of new information technologies: the access to photocopying equipment in industrialized countries tends to reduce the economic returns on commercial publishing, with the result that prices on books and periodicals go up. The increased cost of printed matter will hit developing countries very hard, and local possibilities for extensive photocopying do not appear within reach at present. Copyright is also having a negative influence on the international flow of information, from the viewpoint of developing countries, in that much of the information which is important and which occasionally originates in the developing countries themselves (e.g., scientific articles, abstracts, data on geological structures) may in fact be issued by various private or public institutions in industrialized countries, and subsequently protected by copyright provisions from being disseminated widely in developing countries.

Political

Because of the fact that an apparently increasing number of information sources are considered strategically important for national defense or economic interests, this information tends to become increasingly difficult to access by developing countries. One aspect of this trend is that growing political tension between superpowers promotes a more widespread use of secrecy and other means of protecting sensitive data. This enlarged realm of protection not only reaches the information directly related to military projects where the need for secrecy is quite understandable but also affects the flow of information that is only marginally related to the defense sector, e.g., the results of research associated with advanced computer systems.

Economic

Economic interests also tend to give rise to protective measures and secrecy. In the case of large transnational firms—which incidentally account for at least one-third of the global financial resources for research and development—most of the information which originates during the firm's research and development is naturally considered an economic asset

and therefore not publicly disclosed. In the case of countries where most economic activities are controlled by the state, similar constraints on the flow of information arise, primarily on account of the strategic role which nearly all economic activities occupy in the defense systems of these states.

It should be mentioned here that high technology increasingly appears to depend on scientific inputs, and consequently that a number of information-generating research activities (including research on solid state physics, lasers and genetics) tend to fall within the scope of either military or commercial interests. The result may well be that essential information inputs are increasingly becoming inaccessible by public systems with serious implications for developing countries.

Cultural

A number of constraints would appear to derive from basic differences in cultural contexts. Two of these merit special attention here: differences in language and difference in the basic modes and priorities of research.

Language barriers, and the fact that an exceedingly small number of languages (e.g., English) tend to dominate scientific and technical communication, will frequently present great difficulties for information users in developing countries. Even though the colonial heritage of a developing country has established one of the major languages of scientific communication among small segments of the population, the indigenous language of the vast majority of users in such a country is nevertheless different; and widespread competency in a second language seldom exists. Also, the resources available for professional interpretation and translation are frequently insufficient to make up for the language gap. With the entry of Japan as one of the major industrial powers, this problem appears to have become even more acute.

At the same time, it has become increasingly clear that the way in which scientific research and development is conducted in the Western industrialized countries and the priorities which are set for research and development in their cultural context may be alienating for many developing countries. For this reason the information generated in industrialized countries and available through international channels may be only indirectly relevant to the problems facing users in developing countries. Because of the problems facing users in developing countries. Because of the difference in educational standards, the information accessible through international information flows can also be difficult to utilize in the developing country. A lack of priorities in research in industrialized countries concerning scientific and technological issues which are vital to developing countries (e.g., diarrhoea), and the consequent lack of information on these issues in international networks, will limit the usefulness of international flows of information.

Constraints on Formal Information Flows at the National Level

The conditions which create constraints on the flow of information at the international level to some extent exist at a national level, too. But, in addition, a number of constraints appear to develop out of specific conditions that exist only at the national level in the developing countries. These constraints can be categorized as follows:

Financial-Technical: information infrastructure, technology.
Educational: training of information professionals and users.
Socio-cultural: motivation, hierarchies.

Financial-technical

There are, unfortunately, very limited financial resources available for expanding information infrastructures in developing countries. Thus the possibilities for assisting the flow of information required for development, from both domestic and international sources, through a comprehensive information infrastructure, are comparatively few. Consequently, there is a strong need to emphasize specialization and priority items in the establishment of information services. The financial constraints at this level accordingly tend to reduce both the extent of available information services and their coverage in terms of scientific disciplines and technological branches.

The technical difficulties of promoting an information flow at the national level in developing countries are primarily associated with the relative lack of advanced information technologies, including reliable telecommunications, access to computers, and photocopying equipment. At a secondary level, there may be a host of technical problems which emerge on account of a weakness in the rest of the technological base in developing countries. For example, the lack of reliable electricity supply may seriously impede the use of advanced information technologies. Another indirect constraint of a technical nature is the lack of qualified personnel and maintenance equipment required for the operation of advanced information technologies.

Educational

One of the constraints which has been discussed most in recent years is the lack of qualified information professionals in developing countries. On the one hand, it appears that there has been a long-run tendency to ignore the need for educational programmes for librarians and information scientists. On the other hand, the problem appears to have been maximized by the new technologies and the key role which they play in modern information services. These advanced information technologies, especially in their present form, have been less than "user-friendly" and the information professional thus tends to become an important source of knowledge in the user's information search.

As the importance of information sources for development purposes is becoming generally recognized in society, the need for user education will expand accordingly. Moreover, the above-mentioned introduction of information technologies also tends to raise the requirements for user education. This vital aspect of the promotion of information flow appears to be largely ignored in developing countries, and therefore becomes very important as a constraint on effective information flow.

Socio-cultural

The socio-cultural constraints at the national level appear to be the aspect of information flow that is most seriously disregarded. In spite of all the problems that emerge as the result of various financial, technical, legal, or other obstacles

to establishing full-fledged information services in developing countries, it should not be overlooked that unless there exists an adequate awareness of and motivation for the actual utilization of available information sources, the creation of various formal information services may turn out to be quite useless.

The key constraint to an effective information flow in developing countries will thus be a widespread lack of motivation to use available information.[3] Such lack of motivation can arise from inadequate awareness of the availability and potential usefulness of information sources, but it may equally often arise from the inappropriate nature of the information offered, or simply the cumbersome way in which information services may function. The absence of motivation to use available information may also emerge as a result of a concommitant lack of economic incentives. For instance, when no economic incentive exists to implement technical standards regarding quality levels (that is, when products of substandard quality level can be sold), information about the standards will naturally not be utilized.

A feature such as widespread hierarchies in a society may be an equally serious constraint on information flows. This is not a phenomenon which is necessarily limited to developing countries, but the experience of these countries tends to indicate that hierarchies often create strong disincentives for subordinates to conduct information searches.

Constraints on the Informal Information Flows at the International Level

Formal systems for information dissemination, which have been the main concern in the analysis presented above, are of course only one element of the total information flow to and within developing countries. The importance of informal modes of communication between scientists ("invisible colleges") and engineers have been abundantly demonstrated, and there is every reason to assume that this kind of information flow is of vital importance in developing countries too. The dimensions of constraints on informal communication may be listed as follows:

Physical: distance, time, instrumentation

Psychological: marginalization

Physical

The contacts which are required for participation in "invisible colleges" at the international level can probably only be gained through the kind of personal relationships which are established during studies, collaborative research programmes, conference attendance, and the like. There are physical limits to the extent to which scientists, engineers and technicians in developing countries can enter into such relationships. The physical constraints of long distances and the difficulties of overcoming these through telephone calls or frequent visits, affects not only the feasibility of entering into an informal information flow, but also the possibility of maintaining such contacts once they are established. In this sense, people in developing countries tend to become heavily marginalized in the informal flow of information at the global level.

The great distances also tend to introduce time constraints. Informal networks of information flow rely to a very large extent on up-to-date awareness, whether in terms of knowledge about research frontiers or in terms of knowledge regarding the forefront of technological development. Current awareness of this sort will be difficult to maintain when a time lag consistently emerges in any international dealings.

Another physical constraint which affects the participation of people from developing countries in informal flow of information internationally is the scarcity of modern instrumentation. Scientific research, as well as basic technological development, is highly dependent on an adequate supply of instruments and equipment, and the fact that such equipment is frequently too expensive or otherwise inaccessible in developing countries seriously impedes discussion "on equal terms" between colleagues from developing countries and those from industrialized countries. Consequently, there may be a tendency to focus on theoretical issues in informal international contacts between these two groups; and a great deal of potentially valuable information of a practical nature may not be covered.

Psychological

Partly as a result of the above-mentioned physical constraints, and partly on account of the fact that scientists and engineers from developing countries may feel the existance of a cultural gap, these people will frequently be psychologically marginalized as regards informal communication at the international level. Even when a scientist from a developing country successfully manages to establish and maintain a commitment to an "invisible college" in the industrialized countries, the resulting cognitive orientation will frequently collide with indigenous cognitive values (e.g., local scientific tradition or priorities). The contradictions which arise from this dual cognitive "membership" may not be directly perceived by people in developing countries as a professional dilemma (although frequently they should do so!), but nevertheless they are likely to pose some inherent difficulties in the maintenance of international contacts.

Equally serious is the basic psychological attitude of people in industrialized countries. For the above-mentioned reasons (both psychological marginalization and inequality in terms of instrumentation), many people in industrialized countries tend to marginalize psychologically their colleagues in developing countries. These colleagues will frequently be perceived as "not able to contribute much" to the solution of pressing scientific and technical problems, and therefore be merely at the receiving end of an informal information flow. Such attitudes may be deplorable, but nevertheless they tend to constrain international exchange.

Constraints on Informal Information Flow at the National Level

Constraints at the national level which affect the informal exchange of information include:

Infrastructure: distances, etc.

Cultural: diversity, departmental barriers.

[3] It should be noted that a widespread under-utilization has been observed in recent studies of information services in developing countries. Lack of user awareness is frequently cited as a major reason for this state of affairs, but lack of incentives to utilize information actively may be an even more important factor.

Infrastructure

These constraints are similar to the physical constraints mentioned above. A lack of transportation or telecommunications infrastructure tends to limit the possibilities of creating informal networks of contracts.

Cultural

The diversity of standards between various educational institutions, research units and the like in developing countries, often implies that a common base for communication between people from these units is difficult to establish. Such differences—for example those between scientists working in prestigious national research units or universities and those who are employed in less advanced institutions or in firms—make it less feasible to establish close, informal information flows at the national level. Such constraints tend to be reinforced by cultural attitudes: it may be "below the dignity" of those employed in prestigious institutions to mix with those from other places. Moreover, such diversity is frequently accompanied by basic departmental barriers within administrative systems. The result is that informal communication patterns, which might enhance the capability of people in developing countries to overcome basic disadvantages in the international flow of information, cannot be established under current circumstances; a fundamental change in attitudes may be required.

Conclusions and Recommendations

The ultimate reason for analyzing the constraints which affect information flow and ultimately the use of information in developing countries is to develop a framework for action. On the basis of the typology which has been suggested above, a number of tentative conclusions emerge regarding the most appropriate framework for action. The table below recapitulating the constraints, summarizes the typology proposed.

Types of constraints

	International	National
	Financial	Financial-technical
	Technical	Educational
Formal	Legal	Socio-cultural
	Political	
	Cultural	
	Physical	Infrastructure
Informal	Psychological	Cultural

In the following paragraphs, some conclusions which may be drawn from such analysis of constraints will be briefly introduced.

Spheres of action

In the discussion of constraints a distinction has been made between various types such as financial, technical and cultural. While it has been emphasized repeatedly that the constraints are interrelated, there nevertheless emerge from the analysis a number of spheres of action.

For instance, there obviously exists an option for subsidizing the flow of information to developing countries by overcoming the financial constraints. One possibility is to reduce the costs of pubications, either by direct subsidy of purchases made by institutions in developing countries or by means of selective purchases by institutions in industrialized countries which then provide these publications to institutions in developing countries free of cost. To a certain extent, the latter kind of action already exists in the form of exchange agreements. Another possibility is to provide preferential access to data bases and/or the telecommunications linkages involved in conducting on-line search from the developing countries.

Another sphere of action might tackle technical problems such as providing new information technology to developing countries or—better still—enhancing the indigenous capability to produce and utilize these technologies. Such action may involve the development of new software packages, or international attempts to standardize systems so that the problem of compatability is minimized.

With regard to informal communication, a sphere of action which is implicitly suggested above involves the improvement of physical facilities for maintenance of international contacts, improved conditions for travel, study trips, or telephone conversations. Most international agencies already place priority on such items as fellowship grants and support for conference participation from developing countries, but actions to reduce constraints on informal communication are less conspicuous at the national level.

Levels of action

Another point which emerges from the analysis of constraints is that one might conceive of several levels of action and possibly several "actors". First, there are a number of constraints the removal of which obviously requires international action, and the active participation of industrialized countries. This is the case with problems of copyright and the patent system. It is clearly also the case with the tendency to protect information for strategic reasons. Second, a number of problems will require national action in the developing countries. This is the case, for instance, when the socio-cultural conditions within the country result in a lack of motivation to utilize available information.

Priorities

The analysis of constraints can also lead to some more concrete thoughts about priorities for action. In other words, there is a need to adopt realistic views of what can be achieved and areas where action may prove futile. For example, constraints which arise on account of the protectionist measures dictated by defense and commercial interests—political constraints at the international level—will be extremely difficult to remove, given the political situation in the world today. This item might therefore not figure as a key priority. But the removal of legal or technical constraints, and the discussion of socio-cultural problems of information flow, may be worth while.

Concerted action

An extremely important conclusion which the analysis of constraints suggests is that the factors affecting information

flow at the international and national level are highly complex and cover a wide range of issues. Therefore, the action undertaken in order to alleviate the disadvantaged situation of people in the developing countries should ideally be systematic and consistent. Merely dealing with one element of this highly complex process or undertaking action in an *ad hoc* manner is not likely to produce much result. What is needed is an agenda of concerted action which includes actors at both the international and the national levels and which deals with more than one dimension of information flow.

Public and Private Data Bases and Services in the United States: Their Availability and Usability in Developing Countries

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Introduction

Information services and data bases produced in the developed countries are of great interest to members of the science and technology sector in developing countries. Access to such services can be facilitated greatly by computers. However, that requires a local computer and the required data bases, or a remote computer system that constraints the data bases; trained local staff to perform searches and analyze search results; local or long-distance telecommunications; and access to the original documents through a library or document delivery service.

Generally this level of activity requires an infrastructure within the countries and regions that allows for the acquisition and support of all aspects of technical information services and user access to them. It also presupposes an infrastructure for institutional development in science and technology.

The purpose of this report is to examine the science and technology-related data bases and information services available from the United States, in terms of their usefulness and availability to scientists and technologists in developing countries. The following topics are addressed:

—Science and technology information in developing countries: an overview
—Information resources
—User requirements
—Information technology
—Costs
—Administrative obstacles
—Interactions with users
—Conclusions and recommendations.

Science and Technology Information in Developing Countries: an Overview

Among developing countries there is wide range of involvement with information services and data bases. Some countries have access to United States-based on-line systems via the major telecommunications carriers. They also use these means of communication for access to electronic mail and document delivery services. Some countries acquire the data bases and run them on their own in-country computers. Many developing countries organizations use on-demand services located in the United States and other developed countries. Where printed sources of abstracting and indexing publications are available in developing countries, manual searches are performed.

In some countries, there are extensive libraries where document citations located by on-line searches can be borrowed or copied. Some organizations have accounts with interlibrary loan services such as the British Lending Library (BLL), or deposit accounts that allow them to purchase documents from organizations such as the National Technical Information Service or the Institute for Scientific Information.

The following sections describes the status of information use in developing countries and the relative necessity of on-line information to the development of science and technology capabilities in a developing country.

Status of information use

Improvements in the use of information services are occurring rapidly in the developing world. At present, the situation is as follows:

Latin America/ Caribbean	United States-based information services have been used extensively in some organizations for the past several years. There are comprehensive libraries and, relatively, more trained personnel than in other developing regions. A drawback is the preference for non-English language materials, in Spanish, French or Portuguese.
Asia, Near East, and Middle East	Newly established telecommunication nodes have made it feasible for on-line searching to be done in these countries. Staff training, utilization of services, and general interest in upgrading information access is increasing. English-language materials are accepted to a greater extent than in Latin America and Africa.

Africa Most African countries do not have access to the telecommunications services that would allow economic use of United States on-line services. There are few trained personnel. Some countries require French-language materials.

In any of the developing countries, vast improvements can be made. The primary issues that must be considered are:

—Lack of infrastructure, well-established channels and networks for obtaining and furnishing information; and administrative action to ensure policy and funding to support the services;

—Costs/budget requirements;

—Scarcity of trained personnel including librarians, information scientists, computer specialists and promoters of information systems and services; lack of training facilities;

—Lack of access to communications and computing technology and adequate maintenance facilities;

—Limited knowledge about information services and their potential, resulting in limited demand for information;

—Physical environment that is not supportive of information technology;

—Political issues and governmental restrictions;

—Commercial firms' lack of interest;

—Programmes targeted to near-term results, usually excluding information activities of any long-term significance;

—Language barriers—lack of knowledge of, or reluctance to use, English-language materials;

—Lack of marketing strategies and activities to promote user awareness of information products and services and interest in them;

—Problems relating to foreign currency;

—Lack of evaluative information about the various information services offered.

These problems are surmountable, and there are several information centres in developing countries that provide on-line information services efficiently and effectively. One such centre, Servicio de Consulta a Bancos de Informacion (SECOBI), had been in operation since 1976. This centre, located in Mexico, responds to individual inquiries. It also supports organizations in setting up their own computer access to on-line services.[1]

Is on-line information necessary?

It can be argued that the on-line information services from developed countries are overrated, in terms of their true impact upon improvements or advances in science and technology, whether in the developed or developing world. Many have come to believe that rapid information delivery is necessary for technological advance, forgetting that the most significant technological gains were made during a period when relatively few formalized information services were available. Most of the currently available information services resulted from the industrial revolution rather than being the cause of those developments.

This is not to say that on-line services are not important, or that developing country users should have to use manual information products rather than their on-line counterparts. However, while the countries are developing their infrastructures for the use of modern information technologies, their scientific and technological infrastructures can be developed without waiting for computer access to information.

On-line access to information is not, then, the difference between present-day developing-country organizations and "industrial age" organizations in the United States. The difference is more likely to be the unawareness of the existence of information. The most valuable "next step" is toward increased awareness of the available services and how to best use their contents, regardless of the mode of access.

Information Resources

This section contains a brief overview of the types of information available through United States data bases, some typical data bases of interest to developing country users, and future trends affecting information availability and use.

Types of data bases available

Various types of data bases may be of interest to science and technology information users. Some of these can be described as follows:

Bibliographic data bases contain citations and sometimes contain abstracts of printed literature, patents, papers, dissertations, books, new stories, reports, and technologies. Document delivery is available for on-line, mail or phone ordering, and documents may be transmitted by facsimile, on paper, or on microfiche.

Referral data bases contain references and sometimes abstracts or summaries of non-published information and are used to refer users to individuals, organizations, audio-visual materials, and other sources of information.

Mixed bibliographic/numeric data bases contain numeric data plus text, particularly with dictionary or handbook type of data for instance, the CNMR data base, which has literature references on Carbon 13 nuclear magnetic resonance spectra and numeric data to identify complete spectra.

Numeric data bases contain survey data or statistically manipulated data, such as time series (some with critical evaluation). Often, subject specialty and interpretive work is required to use numeric data bases to full capacity.

Properties data bases show physical or chemical properties, structures, or spectra, or systematic nomenclature.

Full-text data bases contain complete text of published items or electronically published items (e.g., *ACS Journal On-Line, Kirk-Othmer Encyclopedia of Chemical Technology*, and *IRCS Medical Science* data base).

Personal message exchange systems allow users to communicate with one or more other users. Messages can contain correspondence-type information, laboratory data, and the like.

United states data bases: origins, subjects, nature of information, and size

United States data bases are produced by many different sources, cover a variety of subject areas, and vary tremen-

[1] *Transborder Data Flows: Access to the International On-Line Database Market*, ST/CTC/41, United Nations Centre on Transnational Corporations, New York, 1983; pp. 132-140

dously in size. In a survey performed in 1982,[2] the United States data bases were found to have the following characteristics:

Organizational types

Governmental	28 per cent
Non-profit	19 per cent
For-profit	52 per cent

Subjects

Business & industry	44 per cent
Sciences & technology	29 per cent
Social sciences - humanities	14 per cent
Multidisciplinary	13 per cent

Nature of Information

Bibliographic	46 per cent
Numeric	34 per cent
Textual-Numeric	12 per cent
Full-text	10 per cent

Size of bibliographic data base

less than 25,000	24 per cent
25,000 - 50,000	11 per cent
50,000 - 100,000	18 per cent
100,000 and greater	46 per cent

Start-up fee: 12 per cent of data bases require start-up fee, mostly for-profit.
Subscription requirements: 25.5 per cent require subscription to printed publications, mostly for-profit.

Typical United States data bases of interest to scientific and technological information users

The following are United States data bases that have been known to be familiar to, and of interest to, developing country scientists and technologists:

BIOSIS PREVIEWS contains citations from both *Biological Abstracts* and *Biological Abstracts/RRM* (formerly entitled *Bioresearch Index*), providing comprehensive world-wide coverage of research in the life sciences, produced by BioSciences Information Service.

CA SEARCH data base contains bibliographic data, keyword phrases, and index entries for all documents covered by Chemical Abstracts Service. Related chemical substance files are CHEMNAME, CHEMSEARCH, CHEMSIS, and CHEMZERO.

AGRICOLA provides comprehensive coverage of worldwide journal and monographic literature on agriculture and related subjects, produced by the National Agricultural Library, United States Department of Agriculture.

MEDLINE covers virtually every subject in the field of medicine, produced by the National Library of Medicine, United States Department of Health and Human Services.

NTIS data base consists of government-sponsored research, development, and engineering plus analyses prepared by federal agencies, their contractors or grantees. Topics include environmental pollution and control, energy conversion, technology transfer, behavioral/societal problems, and urban and regional planning. Produced by the National Technical Information Service, United States Department of Commerce. (Produced appropriate technology bibliography).

SCISEARCH contains all the records published in *Science Citation Index* and additional records from the *Current Contents* seres of publications that are not included in the printed version of *Science Citation Index*. (A citation index extracts all publications cited in a given article and indexes them in various ways, in addition to indexing the article itself.) Produced by the Institute for Scientific Information, Inc.

DEVELOP, prepared by Control Data Corporation and furnished via Denver Research Institute, contains contributions from many development organizations. Subfiles include citations on publications, ongoing research, organizations, and individual specialists.

VITA data base contains references to appropriate technology literature, from the United States and from developing countries. Usually a bibliography and copies of pertinent articles are furnished to the requester. This service is furnished by VITA (Volunteers in Technical Assistance).

All of the above data bases are available through the online services except for the DEVELOP and VITA data bases. Both of these are searched by their respective organizations, in response to letter, cable, or telephone requests. The VITA data base has been input to the DEVELOP data base.

The data bases sponsored by United Nations organizations also are highly relevant to developing country users' needs. These include AGRIS (Agricultural Information Systems), sponsored by the Food and Agriculture Organization (FAO), and ASFIS (Aquatic Sciences and Fisheries Information System), sponsored by FAO, the Intergovernmental Oceanographic Commission of UNESCO, and the United Nations Ocean Economics and Technology Office. Both of these data bases contain input from their counterpart organizations in the United States.

Choosing and using data bases

In addition to the files mentioned above, there are numerous other data bases and services of potential interest to developing-country scientists and technologists. It is recommended that the serious investigator of the use of data bases consult directories and publications that list and report on the various available files. The following directories of online services are recommended:

Directory of Online Data Bases
Cuadra Associates
2001 Wilshire Blvd., Suite 305
Santa Monica, CA 90493, United States
US$ 75/yr subscription, includes updates

EUSIDIC Database Guide
Learned Information
143 Old Marlton Pike
Medford, NJ 08055, United States
US$ 50 plus postage (Note: Learned Information also maintains a data base on data bases.)

[2] Wolff-Terroine, M., et al, "Main Trends in Royalty Policy of Database Producers", *Online Review*, 1983, vol. 7, No. 2, pp. 101-109.

Directory of United Nations Data Bases and Information Systems, GV.E.84.05
ACCIS Secretariat
Palais des Nations
1211 Geneva 10, Switzerland
Scheduled for sales early December, from United Nations Sales Section in New York and Geneva for US$ 35.

The number of data bases to choose from creates a problem for new (and even more experienced) information users. Much evaluative research has been done on data bases, overlaps in contents between and among data bases, and strategies to use them effectively. There are a number of journals that report these findings, including *Database*, *Online Review*, and *Online*. The "International Comparative Guide to Databases Online", published in the fourth issue of *Online Review* each year, provides valuable information on the current costs of the major data bases.

The major suppliers of bibliographic data base service in the United States are the following companies:

Dialog Information Services, Inc.
3460 Hillview Avenue
Palo Alto, CA 94304

SDC Information Services
2500 Colorado Avenue
Santa Monica, CA 90406

BRS
1200 Route 7
Latham, NY 12110

Each of these companies published a catalog of the data bases it furnishes, along with the costs for the various data bases.

Other suppliers are listed in the directories referenced above.

Document delivery service

One of the major considerations of developing-country users of data bases is the difficulty in acquiring the original publications announced in the data bases. Usually it requires three weeks or more to obtain the documents, and the cost of the document plus the delivery charges may be prohibitive.

The most satisfactory means of acquiring documents is by establishing an account with organizations in the developed countries who provide the service to the developing country organizations on a regular basis. These include some data base suppliers, large libraries such as the British Lending Library, and private foundation brokerage firms. Some of the data base suppliers also provide lists of brokerage firms and their addresses and rates.

The National Technical Information Service sells copies of the documents announced in the NTIS data base, either through deposit accounts or, for infrequent or one-time purchases, by cash-on-delivery or by credit card charging.

The Institute for Scientific Information, Inc. provides a document tear-sheet service whereby publications announced in *Current Contents* may be ordered and purchased.

One of the problems that has been raised has been the inability to evaluate services, especially when the user is located in a distant country. Some developing-country users have received inferior service from certain brokerage firms in the United States. At present, the best approach to selecting a firm is to contact existing information centres in developing countries and learn what their experience has been, and whom they might recommend. Perhaps in the future there will be a certification procedure, but none exists now.

User Requirements

In general, there are three groups of users of information services in developing countries: (a) science and technology policy makers and managers, (b) universities and research and development institutions, and (c) small industries and entrepreneurs.[3]

The following sections describe the information habits of the users and their information requirements.

The users

Of the three user groups, **science and technology policy personnel** may be the users most remote from technical information resources. However, those policy makers whose educational backgrounds included science and technology would retain their familiarity with the services they used as students. In some cases, their information use is likely to replicate that of research scientists (described below). Important information resources would come from informal channels and colleagues, or from regular liaison with academies of science and science-related ministries in their own or other countries.[4]

Academic and research and development scientists have the closest ties with information services. Many developing country universities and research and development organizations have access to printed abstracting and indexing publications through their libraries. These publications may include the standard services such as those described in the section on information resources. Many scientists have used these and other similar publications while performing research for graduate degrees. Some continue to use them, while others do not. This is true of scientists in both developed and developing countries. Scientists traditionally have formed informal exchange mechanisms with colleagues by personal communication and by attending conferences in their fields. This seems to be especially true of developing-country scientists.

Industrial scientists also may have become familiar with traditional abstracting/indexing publications during their scientific careers. However, in developing countries these scientists are less likely to have access to extensive technical library resources. Also, their information needs will more likely be about small-scale industrial equipment and machinery (e.g., suppliers, maintenance support, availability of spare parts), environmental requirements, regulatory information, and other types of data not readily available through a conventional information acquisition programme.

[3] Another group that has an interest in science and technology information is the informal or semi-urban sector. However, this group usually requires information that has been repackaged and perhaps translated from English before the information can be used. This group will not be addressed in this report.

[4] Science policy literature has become more organized recently. However, it may be one of the subdisciplines that is not channeled regularly into data bases. Our experience in developing the National Energy Information Centre in Thailand has shown that it was necessary to establish contact with information sources outside of the traditional literature channels to obtain materials on science policy.

As the above paragraphs show, there is no "average developing-country information user." Diverse and dispersed groups of users have many different levels of capability and understanding of both the content and the technology important for using information services. The regions or countries where these user groups are located may likewise have very different levels of sophistication in their infrastructure for accessing, processing, and transmitting information. In addition, there are constant changes in (a) users' own information awareness and perceived needs, (b) the availability of information, both computer-stored and printed, (c) technological aids, and (d) administrative facilitation of access to information.

To compound the problem, users representing different levels of technical interest must be addressed. These include administrators and managers, research and development scientists, technicians, information specialists, and business/industry representatives.

Information requirements

Despite the differing needs among the user groups, there is a general requirement that all necessary science and technology information be delivered to users **promptly**. The data need to be comprehensive and well-targeted to meet the requestor's requirements.

Table 1 shows a matrix of the three user groups' primary functions, the types of information they require, the usual sources of this information, the information service or resource from which it can be obtained, and examples of data bases. This matrix attempts to show the full range of information services that might be required to meet information needs, rather than showing only those bibliographic data bases that are most familiar.

The matrix assumes a simplified view of what are probably the major information needs of each user group. In reality, each user group may take on more information needs depending on local environment, organizational structures, and expected functions. The matrix does not delve into how the user groups actually use information and where they get it. Generally, person-to-person and conveniently located sources are used most, with some individuals and subgroups scarcely using print sources and other (for example, scientists) relying primarily on them. This orientation can cut across the three user groups in the matrix. Also, critical evaluation and selection are important for some kinds of information and not necessary for others. And, there is some indication that subjects remote from one's own specialty are learned about through more general published sources.

Relevance of United States data bases

The relevance of many United States data bases to developing-country science and technology needs has been somewhat limited. There is a broad range of requirements within developing countries. The most basic research may be useful to some scientists; others may need high technology applications. Still others can make use of only the simplest of applied technologies.

Representatives from Chemical Abstracts Service, BioSciences Information Service, and NTIS indicate that, generally, developing-country users find relatively little material of interest to them in those organizations' data bases. Exceptions are those institutions, for example in Latin America and the Middle East, where there are not only more scientific activities, but where the data bases have been available for some time. This would suggest that two factors are important: (a) an established scientific and technology infrastructure in the country, and (b) longer exposure to the availability of the data bases.

At present, the United States-generated data bases contain relatively few titles from the developing countries. This situation, much like the chicken-and-egg dilemma, is likely to continue until developing country organizations become more active users of these data bases. That should result in paving both sides of the two-way street. Developing-country organizations will become aware of the possibility of furnishing their materials for input to United States data bases. At the same time, United States data bases producers will seek out the types of materials that they know will better serve their developing country clientele.

The experience of United States organizations in serving developing country information users indicates that relatively few requests are made for information on high technology issues. A survey of users from Central and South American research organizations and entrepreneurs with private companies showed that requests generally fell into the following categories:

—agriculture/aquaculture, e.g., methods of irrigation, rain-fed agriculture, prawn and shrimp farming, growing coriander, different uses for prawns, how to make beer, different uses for semolina.

—energy, e.g., wind energy and electric turbines, equipment necessary for building power plants (one of the few higher technology requests).

—technology, e.g., equipment necessary to manufacture meat pies, different uses for wood waste and sawdust, crop driers (Who makes them? How are they made?) hand pumps.

This test project required the use of the DEVELOP data base along with three or four other data bases, as required. The DEVELOP data base consists of subfiles input by several appropriate-technology and development-related organizations. In this case, many of the useful items retrieved were input by VITA.

Performing these searches required in-depth investigation of the data bases' contents to be able to retrieve anything relating to the requests. There seemed to be relatively little published in these areas that was included in the data bases. Another challenge was being able to determine when a high-technology publication was required to satisfy a request, e.g., an article on materials properties in response to a request for equipment availability or production.[5]

It should be noted that these examples are not meant to be indicative of all developing country science and technology information needs. However, the topics to represent present-day information requirements of developing country science and technology organizations. This report addresses not only current requirements, but also those needs that will arise as science and technology institutions proliferate throughout the developing world.

[5] Information on this project was furnished by Janet H. Kubalak, formerly of Capital Systems Group, Inc., contractor to USAID. Ms. Kubalak was one of the persons responsible for performing searches in response to the developing countries' requests.

Table 1. Information resources required for user functions

Functions	Type of information needed	Captured in	Available from	Examples
Science technology policy	Country status, trend, forecast	Reports	Bibliographic data bases*/	PAIS (Public Affairs Information Services)
		Newspapers	Source/numeric data bases	World Bank Tables
		Newsletters	Full-text data bases	Bi/Data (Business International
		Person-to-person	Information centres/services	Time Series National Data
	International status, trend forecast	Reports	Bibliographic data bases*/	
		Newspapers	Full-text data bases	
		Newsletters		
		Person-to-person		
	Research, research and development results, trends	Technical reports	Bibliographic data bases*/	ISI-SCI (Science Citation Index)
		Conference papers		NTIS (National Technical Information
		Books		Service/U.S. Government-sponsored R+D)
		Refereed journals	Full-text data bases	Chemical Abstracts
		Trade press		AGRIS
		Person-to-person		ACS Journals Online
	Government(s) Activities	Reports		
		Memos, internal papers	Internal systems	NEXIS Full Text World Press, newsletters
		Newspapers		
	International agency(ies) activities	Reports	Bibliographic data bases*/	PAIS (Public Affairs Information Services)
		Newspapers		

*/ May necessitate use of document delivery services or libraries to acquire actual documents identified or described in data base.

Table 1. Information resources required for user functions (cont'd)

Functions	Type of information needed	Captured in	Available from	Examples
Science and technology	Expert assessments	Person-to-person Refereed journals Data bases	Referral data bases VITA Technical assistance Numerical data bases*/	American Men and Women of Science Develop Federal Research in Progress Commerce Business Daily
	Research in progress, new directions in research	Proposals Contract awards Interim reports	Bibliographic data bases*/	
Research and development	Research, research and development results, theories	Technical reports Conference papers Meetings Books Refereed journals Trade journals Patents Person-to-person Demonstration Videotape courses	Bibliographic data bases*/	NTIS (U.S. Government-sponsored R&D reports) Engineering Meetings BIOSIS (Bio Sciences Information Service) Chemical Abstracts Medlars AGRIS/ASFA Health Audio-Visual On-Line Catalog AMA/NET (evaluative information on drugs, diseases, procedure, nomenclature, clinical literature)
	Nomenclature	Directories, encyclopedias, handbooks	Fulltext/Bibliographic*/ Numeric data bases	Kirk-Othmer Encyclopedia of Chemical Technology

*/ May necessitate use of document delivery services or libraries to acquire actual documents identified or described in data base.

Table 1. Information resources required for user functions (cont'd)

Functions	Type of information needed	Captured in	Available from	Examples
Research and development	Data	Data bases, directories	Numeric data bases	Chemname (Chemical Substance File)
	Structure/Property	Data bases	Numeric data bases	MSSS (Mass Spectral Search System)
	Statistical analyses/ Models/Data manipulation	Data bases	Numeric data bases	XTAL (Single Crystal Reduction and Search System)
	Procedures	Demonstrations		
		Person-to-person	Referral data bases	American Men and Women of Science
	Expert assessments	Directories	Referral data bases	ISI-SCI (Science Citation Index)
		Person-to-person	VITA, technical assistance	
		Refereed journals	bibliographic data bases */	
		Data bases	Numeric data bases	
Technological applications + industrial development	Company/Product contact	Directories	Referral data bases	Dun and Bradstreet Market Identifiers
	Company/Product Developments	Reports	Bibliographic data bases */	PTS Prompt (World Literature)
		Newsletters	Full-text data bases	National Standards Association Standards and Specifications
		Conferences		Dow Jones Retrieval Service
		Patents		
		Newspapers		
		Trade journals		
		Standards		

*/ May necessitate use of document delivery services or libraries to acquire actual documents identified or described in data base.

Table 1 Information resources required for user functions

Table 1. Information resources required for user functions (cont'd)

Functions	Type of information needed	Captured in	Available from	Examples
Technological applications + industrial development	Technology applications/ Techniques	Patents Technical reports Person-to-person	Bibliographic data bases*/ Referral data bases	World Patent Index NTIS (National Technical Information Service)
	Country economic/ Demographic	Reports Data bases	Bibliographic data bases*/ Full-text data bases Numeric data bases	BI/Data
	Marketing	Trade journals Newspapers Newsletters Press releases Annual reports	Bibliographic data bases*/ Full-text data bases	ABI/Inform (Marketing and Management Data Base)
	Government activities	Newspapers Newsletters Notices, internal reports	Bibliographic data bases*/ Full-text data bases	NEXIS Dow Jones Retrieval Service
	Funding/Investment/ Import/Export	Reports Newsletters	Bibliographic data bases*/	SOFIE (Sources de Financement des Enterprises) Dr. Dvorkovits Licensable Technology Data Base

*/ May necessitate use of document delivery services or libraries to acquire actual documents identified or described in data base.

Many developing countries are planning to develop, build, or expand and improve science and technology institutions. Over the next 5 to 20 years, there could be significant advances in science and technology activities in these countries. During this period, all aspects of science and technology will be examined, thus requiring access to all related information services.

Future trends affecting information availability and use

There are a number of services under development that will be important to developing country institutions, since they will allow some bypassing of existing complications regarding access to United States information services. These include:

- —end user (chemist at the bench) access to full text of major periodical referred literature on line;
- —access to hard-to-get source data, properties data, and ephemeral literature;
- —expert systems that solve problems using data and knowledge in a field;
- —distribution in new media at lower cost and more targeted to user abilities and needs—e.g., microcomputer disk distribution of subsets of data bases as now offered for BIOSIS;
- —support for downloading and reuse of information that is retrieved, and for manipulation/comparison of internal information with outside information.

The latter two services are described in more detail in the following section of this report.

Impacts of Computers and Communications

This section addresses some uses of computers in providing data base services in developing countries. It also describes the availability of telecommunications services throughout the world.

Computer applications

Some countries have introduced, or are planning to introduce computers into their information processing schemes. Many of the present installations are mainframes or mini-computers. Some of these are being used to access United States data bases via agreements that have been established with the suppliers. In order to use the data bases, retrieval systems are required. There are a number of these systems available, through United Nations organizations (e.g., ISIS), or others like IDRC/Canada. Some are provided free of charge, or for a nominal price, to developing country users. Others are sold by private companies in the United States and other countries.

The ISIS system runs primarily on mainframe computers. MINISIS is tailored specifically for the Hewlett-Packard 3000, a mini-computer that costs approximately US$ 100,000.

Availability of micro-Computers

Many developing country organizations are introducing micro-computers into their information processing schemes. With a telecommunications modem the micro-computer can be used as a terminal to access the online data bases, if there is appropriate telecommunication service available in the country. The problem in using mini-computers for the bibliographic data bases is that of storage capacity. The data bases are far too voluminous to be stored in their entirety in micro-computer storage.

In response to this problem, users have been looking into the use of small subsets of the data bases on micro-computers. These subsets can be obtained from the large, mainframe systems through a process called downloading. Portions of the mainframe's files are selected and transferred to micro-computer disks which can then be manipulated by the micro-computer. Use of the data in this way must be cleared with the data base suppliers or vendors (see the section of this report dealing with administrative obstacles).

Some data base suppliers are meeting this relatively new requirement by furnishing subfiles on micro-computer disks for a relatively low subscription price. BioSciences Information Service (BIS) is making subsets of BIOSIS available according to broad subject categories, or according to a user's profile or subjects. These subsets are charged according to the quantity of references plus a separate charge for individualized profiles. The files can be read by most micro-computers, and several retrieval programmes have been used with them successfully. In addition, BioScience Information Service offers BioSuperfile, a software package that is provided to subscribers for US$100.

Other retrieval programmes are sold for use on micro-computers, either for an organization's own retrieval file or with the major date bases that are allowed to be downloaded or otherwise subdivided. These include the following:

- —CAIRS, Info/Doc, P.O. Box 17109, Dulles International Airport, Washington, D.C. 20041, United States
- —MicroDIS (A micro-computer version of Minisis), Center for Information and Evaluation, United States Agency for International Development, Washington, D.C. 20523, United States
- —SciMate, Institute for Scientific Information, 3501 Market Street, Philadelphia, PA 19104, United States
- —Personal Bibliographic System, Personal Bibliographic Software, Inc., P.O. Box 4250, Ann Arbor, MI 48106, United States
- —Golden Retriever, Capital Systems Group, 11301 Rockville Pike, Kensington, MD 20895, United States

These packages are sold inexpensively, some for US$ 2,000 or less.

Many organizations choose to create their own retrieval programmes from data base management systems, e.g., from DBase II or III. This is relatively easy to do.

Computer hardware/software incompatibility

The most challenging aspect of using data bases via "in-house" computers is that of computer hardware and software incompatibility. Each of the data bases is produced on a particular kind of hardware and is searchable using a particular kind of software, with little uniformity in what is required from one data base to another. In addition, some of the older United States Government data bases operate only through a specific mix of hardware and software that is not easily available in today's marketplace.

Serious consideration must be given to the various costs and the specific equipment and programmer requirements before entering into a plan to operate the data base via local facilities. This is especially true for developing country organizations because of their geographic distance from the data base suppliers and vendors who must be called upon for assistance with the implementation and maintenance of retrieval systems and their applications to the various data bases.

Telecommunications

Efficient access to on-line information services generally requires a modern telecommunications infrastructure. The availability of telecommunication modes in and near developing countries is improving each year. An exhaustive survey of available nodes has not been done for this report. However, the following nodes has not been done for this report. However, the following nodes are now available via GTE Telenet Communications Corporation's International Information System:

North/South America	Middle East/ Africa	Far East/ Pacific
Argentina	Bahrain	Guam
Bahamas	Gabon	Hong Kong
Barbados	Israel	Korea
Bermuda	Ivory Coast	New Zealand
Brazil	Saudi Arabia	Philippines
Chile	South Africa	Singapore
Colombia	United Arab Emirates	Taiwan
Costa Rica		Thailand
Curacao		
Dominican Republic		
French Antilles		
Mexico		
Peru		
Virgin Islands		

Table 2 shows the information available from the supplier, for each country. There is a wide variation in the types of charges required in the various countries.

Transborder data flow

The transborder data flow issue has been looming ever since foreign countries developed a demand for use of on-line services. There have been significant advances over the years during which international and national groups have been lobbying for improved access to the services via improved telecommunications. There is much more to be accomplished. However, the presence of telecommunications nodes in so many countries is an indication of progress.

Table 2. Information available from telecommunications suppliers

THE PHILIPPINES

THE PHILIPPINES TO TELENET/United States:
Public Dial-In Service at 110-300 bps
Leased-Line Service Available
RATES:

Subscription Charge:	None
Connexion charge:	$ US 12.00/Hour
Traffic charge:	$ US 0.60/Kilocharacter
Minimun charge:	15 Minutes/connexion
Telephone access charge:	Varies with distance

GATEWAY LOCATION:
Manila

ACCESS POINTS:
Manila (local access)
Any city with long distance telephone call into gateway

CONTACTS:
Mr. Roger M. Pura
ETPI
115-117 Esteban House
Legaspi Village, Makati
Metro. Manila, The Philippines
Telephone: (632) 856-011
Telex: 63305 ETPNET PN
Trouble Reporting/Customer Service:
Nick Holgado
(632) 856-011

Mr. George E. Tan
Director, Marketing
Philippine Global Communications, Inc.
8755 Paseo de Roxas
Makati 3117
Metro, Manila, The Philippines
Telephone: (632) 815-1680
Telex: 23012 SVPMS PH
Trouble Reporting/Customer Service:
(632) 408-475/499-001

Mr. Antonio M. Urera, Marketing Director
Globe-Mackay Cable and Radio Corporation
ITT Building, 669 United Nations Avenue
Manila RP 2801, The Philippines
Telephone: (632) 50-60-81
Telex: 742-0005

CARRIER:
ITT, RCA, WUI

Costs

Costs are a significant factor in the decision to implement information services. The following sections address the costs involved in operating an information service, accessing data bases, and purchasing computer equipment. Ways to economize in on-line searching are also presented.

Costs to operate an information service

It is nearly impossible to estimate the total costs for operating an information centre. The range of operating budgets for

some developing country information centres is from $ US 500,000 to several millions of dollars. Especially expensive is the development of a comprehensive library or document repository.

However, it is possible to establish an information searching activity by locating it within an existing organization, preferably one that has a library and one or two staff members who would be appropriate for training and subsequent part-time involvement with searching. Such an operation, with a modest amount of searching and document purchase, can cost as little as US $20,000 a year.

Costs to use data bases

Data bases can be searched by direct access to the supplier, through intermediaries, or by leasing the files for local use. Tables 3, 4, and 5 show typical costs for accessing data bases by these three methods. These costs do not include the budget required to operate the physical plant within which the services will be performed.

In Table 3, the various costs required for direct access to information service suppliers are displayed according to hourly search charges plus charges for each record displayed; start-up costs for hardware and software to allow for use of the services; subscription/initiation fees; telecommunications charges; and cost for delivery of the search results. The actual costs of the documents are not included.

Table 4 gives costs for using the information services through intermediaries such as information brokers. Again, the actual costs of the documents are not included.

Table 5 gives costs for use of the data bases within an organization, i.e., where the data base has been leased to be run on the organization's own equipment. This exhibit does include estimates of the costs of documents.

Start-up costs shown on Table 3 are based on computer equipment purchases described in the next section.

These costs may seem to be high. However, it must be borne in mind that these data bases are extremely expansive to develop and maintain. Many of them require multi-million-dollar operations to collect and process the information, and then prepare it for delivery to the user, either by publications or by computer-readable media. Shipping and handling the materials also is costly. For foreign clients, this requires special mailing, sometimes special wrapping, and, usually, currency exchange. Special communications costs may also be incurred.

Costs for computer equipment

Computer mainframes are very expensive, and their costs are difficult to estimate because of the wide variety of peripherals than an organization might elect for the many functions the computer must serve. Mini-computers such as the Hewlett-Packard 3000 can cost in the hundreds of thousands of dollars, a cost that is prohibitive to many developed country information centres as well as to their developing country counterparts. Micro-computers, however, are more reasonable, if one takes into consideration some of the limitations they present, as addressed in the section on the impact of computers and communications. This report, therefore, furnishes more detailed information on micro-computers.

Any computer terminal, communicating word processor or micro-computer compatible with local telecommunications protocols can be used for searching on-line data bases and supporting administrative operations.

A typical mix of micro-computer hardware and software packages that support the information function are:

- —Micro-computer with two disk drives, monitor and keyboard
- —Modem that functions at 1200 baud communication rate
- —Printer
- —Packaged software for communications, word processing (edit, format), electronic spreadsheet, and data base management

Graphics software and printer also may be needed to serve some science and technology users.

Costs for some typical equipment range as follows in $ US:

Low cost	
Radio Shack or Apple 64K computer, dot matrix printer	2,300
Modem	600
Software	1,000
	3,900
Mid-range	
IBM PC XT with 192K, two 360K disk drives, letter quality printer	6,500
Modem	600
Software	2,000
	9,100
High cost	
Alpha Micro and comparable 16 bit micro-computers, sophisticated retrieval and data base software such as STAR[6]	20,000
Modem	600
Other software	2,000
	22,600

Because of the need for equipment backup, a minimum of two machines is recommended.

The above costs do not include salaries of personnel. At least two staff persons who are skilled in operating the machines and searching the on-line services are needed. Persons who are capable of programming the machines are also desirable.

On-line search economics

In planning a budget for on-line searching, there are a number of factors to take into consideration:

- —location (proximity to the computer system) and the type of communications service used;
- —terminal equipment (e.g., if telex, it will have only one-third the speed of a regular terminal, thus costing approximately three times as much for on-line charges);
- —whether citations are printed at the terminal or printed at the computer's location and mailed;
- —whether full or partial citations are printed;
- —which of the on-line services and data bases are used.

The following items generally are charged separately:

- —amount of time the terminal is connected to the computer;
- —amount of time the terminal is connected to a telephone line or network;

[6] Available from Cuadra Associates, 2001 Wilshire Boulevard, Suite 305, Santa Monica, CA 90403, United States.

Table 3. Costs of direct access to on-line data bases in science and technology

(in $US)

Types of data bases	Search charges	Start-up costs	Subscription/ initiation fees	Telecommunications	Delivery cost per request
BIBLIOGRAPHIC DATA BASES Examples: AGRIS ASFA CHEM ABSTRACTS ISI-SCI MEDLARS NTIS	$25-$300/hour + $.30-$50 per record printed or typed Available on DIALOG 1985 $78/hour + $.38/record printed or $.28/record typed $68/hour + $.25/record printed to $.15/record typed $165/hour+$.25/record $35/hour+R.15/record $45/hour+$.17/record	HARDWARE/SOFTWARE PURCHASES -Low end (search, basic display and print) $4,000 -Mid-level (search, display, manipulate, graphics) $7,500 -High end (search, display, manipulate, data base developed graphics, local electronic networks) $22,000 USER MANUALS, DIRECTORIES, THESAURI -$200 per on-line system -$50-$100 per data base TRAINING (exclusive of travel and expenses) -$150 per on-line system, data base specific or advanced training extra	Zero to $30,000 per data base. Most bibliographic data bases available for no or low fee. Many numeric data bases require subscription for access. Monthly minimum may be set by on-line systems.	$6 - $20/hour Connect charge + Volume charges $.40 - $16/unit (See country list)	$1 - $5 per request to order. $3 - $10 AIR MAIL per request to receive. Long distance charges accord according to location.
NUMERIC/SOURCE DATA BASES (INCL. STRUCTURE/PROPERTIES DATA BASES) Example: INDEX CHEMICUS	Negotiable, depending on processing done; retrieval only comparable to bibliographic $160/hour + $.16/record printed				

(Note: Prices subject to change and may vary with discounts, special arrangements for volume users or special categories of users.)

Table 3. Costs of direct access to on-line data bases in science and technology (cont'd)

(in $US)

Types of data bases	Search charges	Start-up costs	Subscription/ initiation fees	Telecommunications	Delivery cost per request
REFERRAL DATA BASES	$45-$100/hour + print and type charges				
Example: American Men and Women of Science	$95/hour + $.40/record				
FULL TEXT DATA BASES	$50-$100/hour				
Examples: ACS Journals	$66-$85/hour				
Encyclopedia of Chemical Technology	$56-$75/hour				

(Note: Prices subject to change and may vary with discounts, special arrangements for volume users or special catagories of users.)

Table 4. Costs of access to on-line data bases through intermediaries*/

(in $US)

Types of data bases	Search charges	Broker fees	Telecommunications	Delivery cost per request
BIBLIOGRAPHIC DATA BASES	$25-$300/hour + $.30-$50 per record printed or typed	$25 - $80/hour Searcher time with minimums.	$8 - $18/hour	$1 - $5 per request to order. $3 - $10 AIR MAIL per request to receive. Long distance charges according to location.
Examples:				
AGRIS	Available on DIALOG 1985			
ASFA	$78/hour+ $.38/record printed or $.28/record typed			
CHEM ABSTRACTS	$68/hour + $.25/record printed or $.15/record typed			
ISI-SCI	$165/hour + $.25/record			
MEDLARS	$35/hour + $.15/record			
NTIS	$45/hour + $.17/record			
NUMERIC/SOURCE DATA BASES (INCL. STRUCTURE/PROPERTIES DATA BASES)	Negotiable, depending on processing done; retrieval only comparable to bibliographic			
Example: INDEX CHEMICUS	$160/hour + $.16/record printed			
REFERRAL DATA BASES	$45-$100/hour + print and type charges			
Example: American Men and Women of Science	$95/hour + $.40/record			
FULL TEXT DATA BASES	$50-$100/hour			
Examples:				
ACS Journals	$66-$85/hour			
Encyclopedia of Chemical Technology	$56-$75/hour			

*/ Includes data base producers who provide searches, commercial organizations and other information services.

Table 5. Costs of other types of access to information in science and technology*/

(in $US)

Types of data bases	Data lease/subscription	Start-up costs	Document delivery	Delivery cost per request
BIBLIOGRAPHIC DATA BASES Examples: AGRIS	---	Minicomputer Hardware/software and supporting operation. (See each data base producer for specifications.)	$10 - $20/item Average document Plus royalties $.25 - $5/page Average document	$1 - $5 per request. $3 - $10 AIR MAIL per request to receive. Long distance charges according to location.
ASFA	$5,500/year, backfile negotiable plus $35/hour Royalty (if serve outside users)			
CHEM ABSTRACTS	$20,000/year plus $1,200 handling fee plus usage fee	Microcomputer Hardware/software (See each data base producer for specifications.)	Plus per page charges for large documents	
ISI-SCI	1984 - $30,000; 1983 - $28,000 1961-1982 - $14,000 each year.		Extra charges for hard-to-get documents or rush service.	
MEDLARS	$15,000 minimum/year plus usage fees			
NTIS	$9,145/year plus usage fee			
NUMERIC/SOURCE DATA BASES (INCLUDING STRUCTURE/ PROPERTIES DATA BASES) Example: INDEX CHEMICUS	Negotiable			

*/ Includes data base producers who provide searches, commercial organizations, and other information services.

Table 5. Costs of other types of access to information in science and technology*/ (cont'd)
(in $US)

Types of data bases	Data lease/subscription	Start-up costs	Document delivery	Delivery cost per request
REFERRAL DATA BASES Example: American Men and Women of Science	N/A			
FULL TEXT DATA BASES Examples: ACS Journals Encyclopedia of Chemical Technology	N/A			N/A

*/ Includes data base producers who provide searches, commercial organizations, and other information services.

—number of citations displayed or printed at the terminal;
—number of citations printed off-line at the computer's location;
—number of SDI (selective diffusion of information) profiles processed, according to the number of profiles processed, according to the number of profiles searched and the number of items retrieved;
—mailing charges; and
—documents purchased.

There are some ways to optimize time at the terminal and related costs. They include the following:

—preparing a search strategy and writing down the subjects and other requirements before logging onto the system;
—preparing several searches to be performed during one session at the terminal; and
—sampling search results online, e.g., looking at the titles to see if the search strategy is yielding appropriate citations, then having the retrieved citations printed and mailed from the computer's location. (However, there may be a charge for each item, whether printed on-line or off-line.)

Usually it is possible to perform several searches during an hour. A search may require only 15 minutes, especially if off-line printing is requested. It may cost as little as $ US 15. However, if a search requires an hour of terminal time and many citations are printed online, it can cost more than $ US 100.

Online searching may seem to be expensive compared with the cost for manual searching. However, on-line costs may be justified for some searches that cannot be performed easily by manual means, e.g., without the capability of searching for words in the text of citations, combining subject terms, and other capabilities that cannot easily be replicated by manual searching. Also, if an organization does not have enough trained personnel (and time) to perform searches manually, that can further justify the costs for online searching.

Administrative Obstacles

The technological barriers to wider use of information services pale beside the long list of administrative problems. These include:

—choosing among rapidly changing services;
—copyright restrictions and fair use;
—limited access information services;
—language barriers;
—currency/payment problems; and
—transborder data flow problems.

These issues are described in the following paragraphs.

Too many choices?

The rate of change of both the content and the technical aspects of information services present extraordinary demands on the individual or organization that attempts to keep up with what is available, at what cost, how soon, and in what format. There is the overlap and duplication of data bases—the same or similar information may be cited in one or more bibliographic data base, or it may be available in full text on others. If an item is cited in a bibliographic data base, it may be described in an irrelevant way. If the document referred to is needed, it can be acquired from any number of sources, ranging from the provider of the data base to libraries or broker services. Each of these possibilities carries varying costs, reliability levels, and time factors. In addition, each data base may be available from one or more on-line vendors, each with a different mix of capabilities, data bases, and user charges.

Data base searching can be done directly or by an intermediary, each with a different set of local arrangements and nodes for access internationally. This diverse scene undergoes constant change, with new, revised, and recombined data bases available in new ways every month.

Meta-information, or information about the information and technology, is crucial to ensure the best cost and benefit relationship for users and to serve their needs appropriately. Training and retraining must be continuing processes. Staff skilled in both searching and information-related areas is needed.

Copyright restrictions and fair use

The information available is printed form or in data bases is copyrighted by the original publishers. In general, this means that users do not obtain any rights to reproduce, electronically transmit, or reuse this information without express written permission of publishers. Some publishers routinely grant requests to reproduce individual items for internal distribution in an organization; others deny such requests, or request a fee for such use of their material. Publishers of many science and technology journals and some books charge royalties on a per-page basis, payable through the United States-based Copyright Clearance Center (CCC). Document delivery services and similar organizations record and report every photocopy made from participating sources when serving outside groups. Royalties are generally charged to users in addition to other document delivery charges. The CCC has signed an agreement with the Copyright Licensing Agency of the United Kingdom to collect royalties for British publications and is currently negotiating with other members of the International Forum for Reproduction Rights Organizations. CCC is also available for independent registration by foreign copyright owners.

Fair use is a concept under United States law related to copyright restrictions on data bases and published materials. In general, fair use permits limited quotation, abstracting, and digesting of copyrighted information, as well as limited copying in the course of conducting day-to-day business. Commercial reuse is expressly prohibited. For instance, if someone searched a data base on a specific topic and routinely redistributed the results to a group of clients, a copyright infringement would have occurred. However, if the same publication were printed (but not duplicated) and then routed to the clients, there would be no copyright violation.

Some information in publications or in data bases is not protected by copyright—news releases and government reports are two examples.

Downloading, or the capture of online information from data bases into local computer storage, is generally permitted by publishers as long as the local storage is only temporary. Temporary downloading to a disk on a micro-computer so

that information can be printed at a different time or speed is not a copyright violation. However, downloading for the purpose of establishing a permanent or even semi-permanent local data base that would keep information available for later reuse is viewed as an infringement by most publishers. An exception to this would be if the local data base were set up by an individual strictly for personal use, with no more than one copy of the information.

Copyright and fair-use restrictions govern reuse of information acquired in published or electronic form for distribution to more than one end user or for developing new information products using search results or documents. The added cost of royalties in acquiring copies of documents can be substantial. Publishers are slow in responding to special requests for exceptions even when willing to grant them. Publishers have a range in levels of restrictions on use of their products, and each of them must be contacted individually for special uses. On-line services provide their users with a list of each data base producer's set of restrictions, but will not answer specific questions about possible infringements or offer special permission in a centralized service.

Limited access information services

There are a number of data bases and information services of interest to developing countries that may have restrictions on their use. Some of these restrictions result from governmental/industrial security requirements. Other restrictions are simply a result of limited funding and staffing within some of the host organizations.

An example of the first type, i.e., security-restricted resources, is the United States Department of Energy data base. Examples of the second type are the data bases of the United States Agency for International Development (USAID) and the World Bank. Both of these organizations provide information services to their respective constituents. In the case of USAID, searches are performed for Washington and country mission staff members, contractors, Peace Corps and private voluntary organization personnel, and other United States Government agencies. In order to have access to this service, one must request information through one of those channels, or request it directly from USAID's Center for Development Information and Evaluation (CDIE) in Washington. Users external to the USAID organization and the United States Government must pay a fee for services rendered. In order to use the World Bank services, one must be a staff member or, if located in a developing country, one may request a search from that country's Executive Officer at the World Bank.

While most other data bases are available for searching through any number of on-line services, a few privately produced data bases require high subscription fees prior to access. The chemical and patent data bases produced by Derwent Publications Ltd. (London, England) are examples of this kind of restriction. Their RINGDOC data bases on SDC's service require a $US 30,000/year subscription for access on-line; Chemical Reactions Documentation Service costs $US 1,185/year. Computer connect time for searching and print charges are additional.

The result of all these restrictions is that some scientific and technical information will not be available to developing countries, or is available only through high fees.

Language barriers

Most major database producers and on-line services are based in Western Europe, the United States, Canada, and Japan. On-line information therefore comes in a variety of languages. The on-line services and data bases from the United States and the United Kingdom are searchable only in English, although training, technical assistance, and documentation in French and Spanish are available for users of some systems. The problem can be further complicated by some of the numeric data bases that not only require a working knowledge of English, but can be used only by persons who have specialized subject knowledge about their contents.

Although a limited number of suppliers in the United States provide translation services, English is needed to tap the full wealth of on-line information directly.

Currency/payment problems

Most data base producers, on-line services, and information brokers require payment in hard currency, usually United States dollars or the currency of the country in which they are based. Suppliers of documents permit a range of payment possibilities, including United States money order, international money order, or credit card charges. A few require prepayment for overseas orders. UNESCO coupons are accepted by the largest of these suppliers in the United States. The need to arrange payment in United States dollars in order to access on-line information and publications, or use intermediaries to do so, is an additional hindrance for some developing country users.

Trans-border data blow problems

Trans-border data flow problems are primarily administrative issues between and among countries' postal and telecommunications authorities. The lack of telecommunications services in some countries is not due to a lack of technological capability. There needs to be continued pressure from the groups requiring the improvements, to ensure more technically satisfactory and less expensive service.

Interactions with Users

It is virtually impossible to use computer retrieval services by having only a computer, appropriate software, magnetic tapes containing the data bases, user manuals, and staff members who have received formal training for use of the systems and data bases. The user interface is perhaps the most important factor in efficient and effective use of information services.

User assistance requirements

Even in the United States, where many organizations have had years of use of the online services, it is recognized that much time goes into user liaison and "hand-holding" activities. The online vendors have a full-time dial-up service line on which staff members assist users, in addition to extensive user aids that may be available on-line.

It is also important to have user assistance available for information requestors who are describing their searches to be performed at another location, e.g., by an information broker in the United States.

In the earlier description of searches performed on the DEVELOP and other data bases, several types of requests were mentioned. However, the persons receiving these requests and trying to respond to them did so with difficulty. The questions were usually phrased in incomplete sentences. When asked what the users wanted searched, their responses were usually words and phrases separated by semicolons, e.g., "uses for good wastes; sawdust". The subjects were broad and imprecise, e.g., "oil" without specifying the type of oil (cooking, automobile, etc.).

In order for services to be used online or remotely, there must be a person available locally who has learned how to use the services and who has used them extensively. The role of this "intermediary" often goes beyond merely providing searching service. For example, the intermediary may have to contact subject specialists on behalf of the user, to better interpret the request. Also, the intermediary might interpret or simplify the retrieved information to ensure that the requester can make proper use of it.

Interviewing the requester

Regardless of the location of the information service and the users, there always will be the need for a good reference interview. Unless the requestor is a frequent user of the services, he or she is unlikely to express exact requirements in the first few sentences. For example, the request may be for a certain article on a given subject. However, the need is rarely for a certain article, but, rather, how to build something, do some process, or the like. A search of data bases may or may not be required. The desired information may be the type that exists only in printed publications, not online. The requester should be informed of what type of information will be obtained: bibliographic citations, abstracts, data, or full text of documents. In getting to the desired results, the requester might be required to perform several hours or days of additional work, e.g., in reviewing volumes of retrieved citations, compiling data, or writing summaries of findings.

Before conducting a search it is important for the intermediary to ask the requestor the following questions:

—How much are you willing to pay?

—Are there any language restrictions?

—Are there any date/year of publication restrictions?

—How many citations are desired? 10? 50? 200?

—Is it important that you have an exhaustive search, even if much of the information is only marginally relevant—or do you prefer fewer, more highly relevant citations? If possible, the requester should be given an estimated of how much material might be retrieved.

—Is there any author or source that you know is active and important in your field of interest? What would be the title of an article/book that perfectly answers your request?

—When do you need the search results?

User training

An extension of the intermediary's role is that of user training. Wherever an information centre or service is formed, users will (and should) be attracted. Some of these will become frequent users, whether on their own behalf or on behalf of their associates. Passing on the various levels of searching knowledge and interpretation skills is extremely important, especially when only one or two trained searchers are available in a country or an extensive geographic area. Training requires continuous attention, staffing, and funds.

Getting new users

The introduction of information services to an organization or geographic area will immediately attract some of the potential clientele. However, many persons will need to be encouraged to use the services. This encouragement has been found to be necessary under the best of circumstances. It is especially important in locations such as developing countries where potential users may not be accustomed to having information services available and have gotten along without them.

Promoting information services is a necessary function that is too often neglected. It requires staffing and funding. Promotional activities must be repeated frequently. They must employ high-quality techniques and materials. Otherwise, the information service's credibility will suffer, and potential users may never become actual users.

Experience in the United States has sown that it requires active promotion and constant reminders for certain types of users to be encouraged to use information services. For example, some research and development programmes require evidence of a search to be presented before funds are contracted. Technology transfer information services at NERAC and WESRAC, information centres co-sponsored by the United States National Aeronautics and Space Administration and two universities, have been designated for use by small businesses who are bidding on innovative research projects through the Small Business Administration (SBA). SBA has required that these firms do a search to prove that their proposed research is, in fact, novel. The information services have been promoted widely and frequently. Thus far, few firms have requested searches from the two organizations.

It is not known exactly why the services have not been used. Perhaps the firms have had searches conducted via other sources, e.g., by requesting them directly from the Department of Defense or other government agencies. Perhaps it is the age-old problem of information users' reluctance to go outside of their own organizations—or, for that matter, walk down the hall to another office—to get the information they need. Perhaps it is because NERAC and WESRAC require payment of $US 125 per search in advance of providing the service, plus payment at cost for purchase of all required documents.

This experience indicates that there is no guarantee that information services will be utilized, regardless of the scientists' and technologists' need to have that information for use in their work. Promotion of the services' value, both to users and to sponsoring or funding organizations, must be an ongoing activity.

User feedback

Another important aspect of information service development is that of obtaining user feedback on a continuing bases. Users' comments should be taken into consideration in tailoring an information service to ensure that it will evolve into a highly successful operation. In addition, as a service is used and appreciated, it becomes more likely that the user organizations will assist with funding, thus allowing the further development and growth of the centre.

Conclusions and Recommendations

It is difficult to generalize about the various user groups, their requirements, their familiarity with information services, the infrastructure they operate within, and their budgets to allow for payment of the services. However, some conclusions can be drawn and some recommendations can be made.

Conclusions

1. United States information services contain information that is valuable for scientists and technologists in developing countries. The relative value of much of the information may not, at this time, be worth the establishment of computerized services and document repositories in some developing countries, especially if there is little or no infrastructure to support their maintenance and use.

2. Scientists and technologists in countries without local access to the services do not have to do without information. There are interim procedures that can be used to obtain the required information.

3. Administrative issues are more instrumental in the availability of information services than technological issues. Local knowledge of the administrative aspects of information services is a requirement.

4. In order to make appropriate use of the services, whether they are based locally or remotely, there must be local representatives who have been trained in the use of the services and, preferably, have had several months of "hands-on" experience in searching the services.

5. Finances must be allocated for information services. Information centre operation may cost from $US 20,000 to several millions of dollars, annually.

6. Close communication with users is required to ensure satisfaction. Where services are being used locally, strong user liaison and full-time troubleshooting services are required.

7. User training, promotion of the services, and user feedback must be provided on a regular basis. This is essential for information services to improve and evolve into a flourishing activity.

8. The value of the content of United States data bases to developing countries must be increased. This should occur as the country becomes a high-level user of the data bases and as the data base producers solicit the country's publications as a means of serving that clientele.

Recommendations

The following recommendations are stated according to the various stages of information infrastructure development that are known to exist in developing countries. This assumes equivalent development in the science and technology infrastructure of a country.

Highly developed infrastructure, where information centres have been established and data bases are searched regularly via local or remote computer retrieval systems for an established clientele.

Recommendations: Increase and improve

—user training activities;

—information science training programmes;

—promotional activities;

—user feedback programmes;

—use of micro-computers for more localized searching; and

—country's input to United States data bases.

Moderately developed infrastructure, where there are some information centres, mostly functioning as libraries, that request searches and documents via intermediaries, e.g., lending libraries or information brokers in developed countries.

Recommendations:

—Pursue all of the activities listed above.

—Increase the use of micro-computing equipment and the use of data bases that partition their contents for specialized needs.

Little or no infrastructure, where use of library services is made infrequently, and perhaps there are no well-developed libraries locally available to scientists and technologists.

Recommendations:

—Designate country and organizational representatives to be trained in the availability and use of information services.

—Send these representatives to the United States or other developed countries to receive training and practical experience in using the services.

—Set up contacts with representatives and organizations in the developed countries whereby new information about the services will be channelled immediately to the developing country representative, and the country's/organization's basic programme and information needs will be recognized, in enough depth for searches to be performed in the developed countries on behalf of the developing-country clients.

—Initiate requests for funds for information services.

—Initiate request for information infrastructure development.

Recommendations for funding by development organizations

Funds should be made available by the United Nations, regional, and national development assistance organizations, for the following activities to further develop and enhance information services for use by scientists and technologists in developing countries:

—development of national centres for co-ordination of information infrastructure development and related activities;

—subsidies for document acquisition and purchase;

—translation of documents to the national language, and translation of those countries' documents to English, etc., for eventual sharing with other countries;

—training programmes for information scientists who will operate online services or serve as intermediaries with services elsewhere; and

—promotional and educational activities for end users of the information.

Development of Information Infrastructure in Developing Countries

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The operation of national information systems and services in the developing countries which are at different levels of socio-economic development and are establishing different information infrastructure gives reason to assert that there is a direct relationship between the possibilities and capabilities of such countries to make use of the world resources of scientific and technological information and the level of their socio-economic development. The differences in the levels of socio-economic development will exercise a decisive influence on the interaction of national, subregional, regional and international scientific and technological information systems within the framework of a global network of scientific and technological information, whose possible establishment is being studied. Therefore objective, up-to-date information about all national systems, as well as the regional ones with which they will interact, may prove necessary in elaborating the concept of a global scientific and technological information network.

The United Nations Centre for Science and Technology for Development (UNCSTD) and specialized agencies of the United Nations do not yet have the results of a comprehensive analysis of the actual state of the developing countries' scientific and technological information systems, made on the basis of a uniform methodology. The reality is that developing countries establish their information infrastructures on the basis of their own understanding of the importance of information and of the role of the information infrastructure. In the establishment of national infrastructures there is sometimes misunderstanding of the fact that any national scientific and technological information system will inevitably become an integral element of a global network and will not be able to develop successfully outside this network.

A global network may before long face situation in which certain developing countries, after obtaining access to information resources, modern technologies, satellite communication, and the data banks of Western information systems and services, may lose national sovereignty if this process occurs outside the United Nations and its specialized information systems and UNCSTD.

It is difficult to formulate the very concept of a global scientific and technological information network without a clear understanding of the real state of things which would make it possible to compare scientific and technological information systems according to certain standard parameters and to outline recommendations with due account of the situation existing in a given country. The only obvious and widespread thesis is that a global scientific and technological information network is a mechanism being set up within the framework of the United Nations on the basis of interaction of the existing national, regional and international scientific and technological information systems and services, including those of the United Nations to ensure full use of the accumulated world information resources and promote socio-economic progress in the developing countries.

Analysis of the state of information and documentation systems of many developing countries gives reasons to distinguish tentatively four groups of countries, provided the main criterion for comparison is the level of development of information institutions and the corresponding scale on which different types of reference and data information are used. These are as follows:

—Countries with a rather high level of development in information infrastructure, which make use of all types of up-to-date information. Access to information in the key sectors of economy in the on-line mode has become a daily practice.

—Countries with an average level of development in information infrastructure, which have set up national information systems, including those in the key sectors of economics and finance. However, lack of expertise and resources and, above all, of qualified users makes it impossible to use effectively even the available scientific and technological information.

—Countries with a low level of development in information infrastructure, in which the functions of information centres are generally performed by national libraries or by small and poorly equipped information and documentation centres. The use of up-to-date information in these countries is insignificant.

—Countries which have no information institutions at all, or countries whose information centres are at the initial stages of development. There is also a large group of countries whose information infrastructure is little known.

A thorough analysis of national information systems may lead to other comparisons. However, it is already clear that there can be no common, standard recommendations concerning the establishment of national scientific and technological information systems adequate to the needs of all the developing countries and to the situation in each. This is true with regard to all elements of the information infrastructure—the user, the information proper, the hardware and

software used, the norms, standards, information retrieval systems, and information referral service. Analysis of the actual state of the developing countries' scientific and technological information systems could be made within the United Nations framework through UNCSTD, UNIDO, and UNESCO, using their present budgets.

Greater progress has been made by the information and documentation systems and services of the developing countries in which the state, even in conditions of limited resources, has oriented the activities of scientific and technological information services toward the solution of the most urgent socio-economic problems. This can be exemplified by India's SENDOC, which is a national service set up to provide information support to small enterprises that are an important sector of the country's economy. A good example has also been provided by provincial information centres established within the national scientific and technological information system in Cuba. They solve one of the key problems of the developing countries, i.e., dissemination of up-to-date scientific and technological information and training of its users.

The desire of the governments of developing countries to manage their information resources, even where the possibilities are modest, is quite natural. This is important from the viewpoint not only of the organization of the information generated in a given country but also the rational use of the information received from abroad. The question of national sovereignty in establishing a global scientific and technological information network is very important. A future network, whatever its configuration, should not depend on any global node, even if it forwards information requests from developing countries to information sources and handles the information flow in the opposite direction. Only under conditions of information sovereignty can the national information policy of a developing country operate successfully. Such a policy should provide for genuine co-ordination of all elements of information infrastructure, balanced planning, and formulation of clear-cut goals in information activity. It is these considerations that should govern the establishment of a global scientific and technological information network.

Among the inadequately developed issues concerning information infrastructure, especially with respect to developing countries, is that dealing with the type of information to be supplied, considering the existing channels through which it can be obtained, the handling technologies, the dissemination methods, and the use of information by different user categories. There are many types of information and many approaches and viewpoints regarding them. If it is possible to establish general criteria regarding types of information and user categories within the framework of a global network, this will allow the types and categories to be linked unequivocally in any given country. We think it necessary to consider conventional information technologies, such as processing of primary sources, abstracting procedures, information referral services, and analytical synthesizing of information for management purposes in the context of a country's level of socio-economic development. The concept and strategy of a global scientific and technological information network will be determined to a considerable extent by the organization of the above technologies within the information infrastructure of a given developing country.

In this context we suggest that three basic types of information should be considered in a possible approach to the solution of the problem:

Reference and data information on published or unpublished primary sources (books, periodicals and serials, proceedings, reports, patents, dissertations, norms and standards).

Information in this area is provided on paper, by machine-readable or micro carriers. Information is accessed in the conventional or interactive (on-line) modes. This type of information is generated by more than 1,800 existing information systems, largely in developed countries.

In setting up a global scientific and technological information network, account should be taken of the world's existing ways and means of accessing the above information, including access through international scientific and technological information systems, on the basis of bilateral agreements (assistance of developed countries to developing ones), through broad exchange, and, lastly, on a commercial basis. VINITI's long-standing experience shows that with proper organization, bilateral and international exchange is a very important channel through which this type of information can be obtained.

Here we would like to make an important comment.

We believe that the problem of accessing organized world scientific and technological information resources is not only financial and technical. If this were so the provision of a terminal linked via satellite communication with a data bank, and the existence of a global node, would solve the problem of access to information and the use of it. But this is not so, which can be accounted for by the fact that, apart from the problem of "access", there also exists the problem of "use". The special value of information, unlike that of any other commodity or product, emphasizes the ability to use information rather than merely having access to it alone. Information use is hindered not only by purely information barriers. It depends directly on the level of a country's socio-economic development and user training.

Specialized, generally subject-oriented, largely data information which is seldom published and which in recent years has been increasingly provided on machine-readable carriers and used on-line.

This information is used for control, management, planning, and design procedures. This type of special information and the corresponding automated information systems are being set up by all developed countries and by an increasing number of developing countries in the industrial, financial, and commercial sectors. These systems are used mainly at the national level at present. The range of users of organized data information is especially wide and varied.

The establishment of information systems of this type promotes the economic advance of developing countries. These systems will undoubtedly become an essential element of a global network. A most important role in the international division of effort with respect to the establishment and maintenance of data banks of such information, and their joint use, should be played by regional and subregional centres organized according to geo-linguistic and geo-economic principles, using the working languages of the United Nations.

Information on industrial and agricultural technologies, both published and unpublished.

It contains data on methods, means and technologies of production, including the characteristics of resources and manufactured products. This is the most complex type of information in terms of structure, ways of transfer, and methods of evaluation. It is provided in the form of industrial descriptions, trade catalogs, and technical know-how. We do not know whether such information is used on-line. It is circulated and used by managers and decision makers as well as by people determining scientific and technical policies and methods of economic development.

This may prove to be the most valuable and expensive as well as the most topical component of the world's information resources in the projected global scientific and technological information network. The use of this type of information entails the purchase of technology proper. Analysis of such information will be required, since in the world market of industrial technologies, information about them in the form of advertisements and other forms of sales promotion is provided in most varied and generally very active forms. At present, such analysis is being done at the international and regional levels by organizations such as UNIDO, TECHNONET, ARCT, RITLA, and many others.

The Soviet Union attaches great importance to the building of national information infrastructures in developing countries. A global scientific and technological information network being set up within the framework and under the auspices of the United Nations can greatly facilitate this positive process. One of the major elements of the problem is that of setting up a higher node of the network management and co-ordination. We do not share the idea of establishing a special global node. One of the possible approaches to the streamlining of information flows, to the establishment of a referral mechanism, and to the selection of appropriate methodologies is the use of the services provided by United Nations specialized organizations, or, to be more exact, of their information systems: UNIDO/UNISIST, ISDS, UNIBID, SPINES; FAO/AGRIS, CARIS, ASFIS; WIPO/INPADOC; UNEP/INFOTERRA; IAEA/INIS; and others. Each of the above information systems can promote within its subject scope the organization of information work in developing countries and in regional centres, and in certain cases they can serve as information donors. It is essential that their efficient interaction should be organized within the global scientific and technological information network.

In tackling this question it would be reasonable to take into account the functions performed by the Intergovernmental Committee on Science and Technology for Development (IGCSTD) on co-ordinating the activities of the agencies of the United Nations system within the framework of the Vienna Programme of Action. However, we believe that the establishment of any coordination mechanism should not result in the increase of the United Nations regular budget. It is precisely the search for possible variants of a mechanism co-ordinating the operation of a global network that should be the goal of the study launched by UNCSTD and the Task Force.

Realizing the needs and the problems of the developing countries, VINITI has for many years been running the UNIDO Training Programme for Industrial Information Officer and Documentalists from developing countries. Through VINITI and in co-operation with the UNCSTD, the Soviet Union is prepared to render assistance to developing countries by providing them with VINITI's abstracting services and data bases in various fields of science and technology, and to hand over to interested developing countries a free retrospective collection of primary sources on science and technology in different languages on the basis of bilateral agreements.

The Soviet Union is also prepared for other forms of aid to, and co-operation with, UNCSTD and developing countries on a bilateral, multilateral, and international basis through the United Nations.

Low-Cost Satellite Communications for Developing Countries

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The Problem

Advanced digital communications techniques and products of the microelectronic revolution are making dramatic changes in the ways information can be collected, transferred, and used to augment limited resources, to manage the growth of technical information, and to deliver information to people at the level of the smallest social units. Nevertheless, the burgeoning information now available on agricultural systems, renewable energy technology, medium-scale industrial equipment, and small-to-intermediate-scale technology is not yet at the disposal of entrepreneurs, peasant farmers, and others operating at the micro level of society in developing countries.

Without access to this wealth of information, developing countries risk falling further behind in managing the information necessary to relieve the pressure on their agricultural, social, economic, and political systems.

The Solution

Volunteers in Technical Assistance (VITA) and the Radio Amateur Satellite Corporation (AMSAT) propose to help developing nations gain access to needed information resources through the use of an innovative, low-cost communications satellite system called PACSAT. This sophisticated technology has the potential to greatly improve the quality, speed, and reliability of information transfer to, from, and among developing countries. Though considerable international discussion has taken place on the use of such satellites, the proposed VITA/AMSAT project is the first to actually put one in operation and thus to put space technology to use in the dissemination of technical information.

PAVSAT gets its name from the "packet radio" switching technique it uses. Like other low-earth-orbit satellites, it passes over a given point on earth several times daily and thus is capable of rapid access from one point on earth to all other points, independent of land-based telecommunications systems. The ground stations it uses are transportable and solar-powered, setting it far apart in cost from other systems. All these features combine to make PACSAT ideally suited to the information demands of developing countries.

The PACSAT system is projected to go into operation in mid-1986. the general PACSAT spacecraft architecture and communications technique will be tested in a research satellite (UoSat-B) scheduled to be launched in February 1984. This satellite was designed by the team at the University of Surrey, England, which will also work on the PACSAT spacecraft. All of the work on the digital communications package is being done by volunteer groups in the United States and Canada, co-ordinated by a full-time technical manager.

The total estimated cost for the four-year project, including all hardware, training, and one year of operational expenses is $US 1,697,550. Of this amount, approximately $US 804,000 has already been committed by the University of Surrey for UoSat-B and PACSAT spacecraft construction. A total of $US 893,550 is now needed to finance remaining components such as engineering prototypes and test units, software development, project management, ground stations, flight hardware, and telecommunications. (See Annex I).

Program Implementation

VITA and AMSAT will jointly manage the PACSAT system. VITA will be responsible for raising additional funds, implementing the project, reporting to donor agencies, co-ordinating the efforts of its volunteers and technical staff, providing technical information resources to the developing countries, and adapting its inquiry response system to the information demands of the world-wide network. After consulting with the host country, VITA will designate project sites and establish at least one of the regional centres at a permanent VITA field station. AMSAT, VITA's sub-contractor in this project, will be the co-manager responsible for administering the technical aspects and handling the high level of documentation required.

AMSAT will also be responsible for designing, constructing, testing and launching the satellite. It will provide highly qualified staff for equipment, programming, and overall system design. With funding support from VITA, AMSAT has already begun to design the system. Four amateur-radio satellites designed by AMSAT have already been launched into orbit since 1970.

PACSAT system resources will be shared by the amateur radio community world-wide, by a network of technical documentation centres affiliated with VITA, by remote field stations associated with VITA's development projects, and by projects involving other non-governmental organizations (NGOs) and private voluntary organizations (PVOs).

The number of ways PACSAT can be used to meet the information needs of developing countries is virtually inexhaustible. In fact, one's imagination governs the extent to which the system is limited. Leaving imagination aside, VITA envisions the following practical applications:

—Field staff working on development projects can relay to VITA other groups' questions in addition to their own, and receive quick responses on a regular basis.

—Field staff in remote, isolated areas can communicate with their home offices and other sources for transmission and receipt of technical information.

—Emergency relief crews can communicate with the central region of an earthquake-shattered country, relaying medical information and tracking down needed supplies for the injured.

—PACSAT allows team travelling in dangerous, rugged territory to relay their location to officials, who can monitor their route in case a rescue mission becomes necessary.

In a polar orbit, a single such satellite equipped with an onboard computer would pass over all points on earth at least twice a day and provide message storing and forwarding and computer conferencing capabilities. Use of VHF (very high frequencies) would keep ground station equipment simple and inexpensive; neither parabolic "dish" antennas nor complex station equipment trained on standard geosynchronous satellites (orbits about 22,500 miles above the earth, where satellite locations appear motionless to observers on the ground) are required.

A technician simply types messages into a computer linked to the satellite, leaves all the radio equipment turned on, and goes about his or her business (depending on local regulations, the presence of a radio amateur may be required to "control" the transmissions). When PACSAT comes within "view" of the ground station, contact is automatically made, the previously prepared messages are transmitted up to the satellite, stored in memory, and later re-transmitted to the correct recipients (who must have access to their own ground stations)—all without operator intervention. Like other electronic mail systems, the technician can transmit "carbon copies" of messages to other related projects or to the home office, or send "private" messages to the home office (government agencies will always be able to monitor the transmissions, however). Similarly, any messages waiting for the technician (for example, technical information in response to a previous request) are transmitted from the satellite to the ground station, where the technician can read them from a printout or computer screen. Where dependable electrical mains are a problem in rural areas, the entire ground station can be powered by several inexpensive solar panels.

Organizational Capabilities

VITA, with its many years of experience in development assistance, and AMSAT, with its in-depth knowledge and application of amateur space communications, are uniquely qualified to undertake this joint venture. Both organizations are sensitive to the societal impact of technological change, yet each is confident that this high-technology project will contribute significantly to the developing world.

VIRA is a major, private, non-profit organization that provides technical assistance to people and groups in more than 100 developing countries. VITA helps people to use their own skills and resources to provide food, water, energy, and shelter. VITA works with inventors, entrepreneurs, governments, and development organizations to develop and diffuse promising technologies.

The heart of VITA is a world-wide network of 4,000 engineers, business people, farmers, energy experts, and other consultants who volunteer their know-how to help others. A technical staff works with them to offer a wide range of services, including by-mail problem solving and technology design, on-site consulting, project planning, and publications activities. In addition, VITA manages major field projects in five developing countries.

Services are offered in most technical areas, but emphasize small-and medium-scale technologies in the fields of renewable energy applications, agriculture and food processing, water supply and sanitation, housing and construction, and small business development. Twice a year, VITA conducts training programs in the establishment and operation of technical information services. In this training and otherwise, in both field and home operations, VITA is committed to the use of microcomputer technology to increase its capacity to transfer information effectively.

Over its 25-year history, VITA has developed its service mechanisms into an integrated system of technical assistance and technology transfer. This permits quick, effective mobilization of both human and information resources appropriate to the problem at hand, and specific to the needs of the individual requester. The essential elements in this unique process are (a) the interaction of all of VITA's parts, which brings the effort to the project stage, (b) the control by the requester at each step on the way to that point, and finally, (c) the flow of information and experience back into the system to improve it and make it more valuable to subsequent users.

AMSAT is a non-profit scientific corporation founded in 1969 that provides satellites for use by amateur radio operators, fosters international goodwill through joint communications studies, and disseminates scientific and technical information derived from communications operations and experiments. Since its inception, AMSAT has been responsible for several successful satellite projects, and has been actively engaged in the preparation of documentation of amateur satellites for the United States government agencies and international communications organizations. AMSAT's activities over the years have also included contract administration and programme planning in association with a variety of communications projects, meetings, and conferences.

ANNEX I: Budget of PACSAT project (in $ US)

Engineering prototypes and test units	
Applications processing unit (APU)	16,400
RAMUNIT (main memory)	8,000
Channel control unit	8,000
Ground station	5,000
	37,400
Flight units	
APU	10,000
RAMUNIT	25,600
Channel control unit	12,000
	47,600

Spare flight units		
APU	5,000	
RAMUNIT	12,800	
Channel control unit	6,000	
	23,800	
Test equipment	10,000	
Total, prototypes and test units		118,800
VITA GROUND STATIONS		
VITA command station	10,000	
Regional stations @ 5,000	15,000	
Portable remote stations @ 2,000	40,000	
		65,000
Spacecraft		
Technical	60,000	
Electronic	42,000	
Test equipment	25,000	
Environmental testing	20,000	
	147,000	
Propulsion system		
Development	30,000	
Flight unit	50,000	
	80,000	
Total spacecraft and propulsion systems		227,000
Launch fee		10,000
Project and management cost: two year period		
Project manager	80,000	
VITA international applications manager	80,000	
Travel	20,000	
Secretarial expenses	26,000	
Total management costs		206,000
Part-time engineering and technical support		60,000
Project travel		
International applications manager	80,000	
On-site training (travel & lodging)	50,000	
Overhead	15,000	
		145,000
Grand total direct costs, PACSAT project		831,800
Estimated value of donated labor: 10,400 hours @ 20,00/hr.		208,000
Grand total - PACSAT project		$ US1,039,800

ANNEX II: Using the PACSAT network in agriculture

The example of India's ability to dramatically increase its crop production comes to mind when considering agricultural applications of a satellite system for developing countries. This is because dissemination of information has been called one of the key factors in the doubling of India's rice production and the quadrupling of its wheat production within the last 25 years. Similarly, information on nutritional needs of farm animals and the nutritional value of feeds has greatly increased the efficiency of India's livestock and poultry production.[1]

Essential, up-to-date information for agricultural decision-making is today available, but usually not accessible, to farmers and development workers of limited resources throughout the world. The communications network envisaged in the PACSAT project will in many cases provide that access. Linked by satellite with documentation centres, agricultural data banks, and other farms around the globe, extension agents in developing countries will be able to request, send, and receive vital technical information from their inexpensive PACSAT ground stations, consisting only of a ham radio, a small personal computer, and a vertical antenna.

Following are a few examples of information needs critical for Third World agricultural development that could be met through access to a satellite network.

1. *Agronomic diagnosis*. Through the use of computer programmes widely available to agricultural enterprises, field problems with crops can be analysed and resolved before significant damage occurs. For example, problems with fertilizer applications, planting schedules, irrigation needs, and varietal selection, can be addressed by using computer-analyzed data. A farmer compiles relevant site-specific data on climate, soils, crops, and field practices, for transmission to VITA or some other centralized data base. Computer-processed recommendations on most effective and economical strategy are sent back to the requester with the possibility of a 24-hour turnaround time.

2. *Livestock*. Locally available feed stocks can be combined to produce maximum nutritional quality blends for specific livestock. Seasonal variations in crop availability, costs, and content can be computer-analyzed at an agricultural data base facility to produce the best possible formulation. Where it has been available, this approach has already resulted in significantly increased productivity and improved livestock health.

3. *Agricultural marketing and buying*. Throughout the world the optimal timing for buying and selling depends on a comprehensive market perspective. Developing-country farmers who produce commodities for cash are seriously handicapped by poor access to this information. Extensive data are available for individual countries as well as international markets, and access to this data would be possible through a satellite network.

4. *Species and varietal selection*. Proper germ plasm selection is the foundation for heightened productivity. Lack of information about improved varieties appropriate for local conditions has severely limited the ability of farms in developing countries to increase agricultural production. Incorporating basic local data (such as data on climate and soil) with field results can, in many instances, avoid chronic misuse of germ plasms.

5. *Data base access*. Worldwide agricultural data bases (e.g., AGRICOLA agris) have compiled extensive information in all disciplines. Access to the data bases is limited to users with elaborate hardware and expensive access rights. Centralized organizations like VITA, with appropriate licenses, can act as a linkage to identify relevant data bases for a requester, and to conduct specific searches.

[1] Agricultural Information Development Bulletin, vol. IV (1982), United Nations Economic and Social Commission for Asia and the Pacific.

6. *Agriculture computer programme service*. Today, agriculture computer programmes are so numerous and diverse that no one agent or small agricultural facility could ever retain all the necessary and available programmes specific to its needs. Through the PACSAT linkage, the proper programme for a particular application could be identified, and actually transferred to a requester via the satellite/radio/computer link. In this way, the terminal at the ground station actually functions as an active computer centre, enormously expanding its capability.

ANNEX III:
Prospective users of PACSAT network

OVERSEAS

Belize	Radio Belize, Belize City
Bolivia	University for Peace, La Paz Mr. Javier Guzman, Oruro
Canada	International Development Research Institute, Ottawa IPRC, Ottawa National Research Council of Canada, Ontario Native Communications Society, Yellow Knife Ryerson Polytechnical Institute, Toronto Third World Resource Centre, Toronto Trigon Systems Group, Toronto
Chile	Latin American Institute of Transnational Studies, Santiago Ministerial Services, Santiago
Costa Rica	Centre of Telecommunications for the Third World, San Jose United Nations University for Peace, Escazu
Ethiopia	Pan-African Documentation and Information System, Addis Ababa
France	UNESCO, Paris CODATA, Paris
Greece	Athens Centre of Ekistics, Athens
India	Action Groups for Development, Nadia Communications engineer, Bombay National Centre for Software Development and Computing Techniques, Bombay Shar Centre, Nellore Systems Research Institute, Pune TATA Research Development and Design Centre, Pune
Italy	Committee for the Aid to Co-operatives (COPAC), Rome
Japan	United Nations University, Tokyo
Mexico	Consejo Nacional de Ciencia y Tecnologia, Ciudad Universitaria
Nepal	Royal Nepal Academy of Science and Technology, Lolitpur
Nigeria	ONO and Partner, Lagos
Panama	Grupo de Tecnologia Apropriada
Papua New Guinea	Appropriate Technology Development Institute, Wau Ecology Institute, Wau
Peru	Consejo Nacional de Ciencia y Tecnologia, Lima NETS (Nueva Estrategia Tecnologica y Social), Lima
Sri Lanka	Arthur Clarke Centre for Modern Technology, University of Moratuwa, Electronics student
Switzerland	International Telecommunication Union (UTI/ITU), Geneva
United Kingdom	Commonwealth Bureau of Agriculture Economy, Oxford Open University, Milton Keynes School of Development Studies, University of East Anglia, Norwich.

UNITED STATES

California

Philippine Appropriate Rural Technology

Assistance Group, Dale City

Connecticut

Technoserve, Norwalk

Hawaii

Pacific Basin Development Council, Honolulu

Illinois

International Services Southern Illinois University,Carbondale

Toward Freedom, Chicago

Iowa

University of Northern Iowa/Shaanxi Teachers University

Xian Province China, Cedar Falls

Missouri

McDonnell Center for Space Sciences, St. Louis

United Church Board for World Ministries, St. Louis

New York

Catholic Relief Services, New York

International Human Assistance Programmes, New York

Seven Winter Association, Inc., New York

Oregon

Hewlett-Packard, Corvallis

Rhode Island

Foster Parents Plan, Warwick

Virginia

IADS, Arlington

Legacy International Youth Programme, Arlington

PART FIVE:

Scientific and Technological Information Network

Some Priorities in a Global Network of Science and Technology Information

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This paper deals with the selection of priorities in setting up a global network for scientific and technological information (STI) for the benefit of all countries and especially of scientists and engineers in developing countries.

Categories of Scientific and Technological Information Users

Emphasis is placed on the needs of researchers and technical personnel, especially the staffs of research centres (public or non-governmental organizations) and of universities and technical schools. The reasons are that scientific and technological information is a feedstock in their productive work and that access to published scientific and technological information is limited in practice not only by local library conditions but also by the cost of purchases of subscriptions, and of telecommunications.

Though the situation differs widely from place to place, a majority of countries with limited resources and budgetary restrictions are faced with great problems in this respect. The rapidly increasing number of titles in the world's scientific and technological bibliography makes them all the more acute.

A second category comprises the scientific or technical staff of small and medium-sized enterprises and the professionals who work independently or in small independent units (physicians, consultant scientists or engineers, and the like). Many users in this category also have very limited resources and poor library facilities.

Users in third category, comprised of state officials and enterprise research or policy staffs, are often less limited by costs, but are hindered practically by the same limitations in locally available library services.

One of the objectives of a world network being to help solving cost-of-access problems in developing countries, the distinction between users with adequate funding and those with less than adequate funding will be kept in mind.

Categories of Primary Information and Literature

Books and articles

One crucial need of all scientists and engineers is access to recently published books and articles in their specialties, scientific and technological information proper, reporting new and original scientific and/or technological findings or achievements. Conference papers and published dissertations are also a part of the scientific and technological information stock.

Hard data

Another need is access to hard data, which means figures, tables, and lists on paper and their equivalent in computerized data bases; this second category is of less general use because hard data bases do not exist in all the specific subfields of science and technology, whereas books and articles cover all possible subjects. A prerequisite for establishing a hard data base or data bank is a very strict standardization of definitions, units, measurement methods, and the like by a group or network of scientists or scientific units (a specialized scientific community).

Right of access may be limited to members or be unrestricted, and fees may differ widely, according to the group's own rules.

Documents about science and technology activities, policies, and management

Administrative data, economic-technical statistics or indicators, budget figures on science and technology, market analyses of advanced products, and the like (often called "grey-literature") are important for policy makers and civil servants with responsibilities in the planning or the management of science and technology activities for development. To the same category belong the state-of-the-art reports, the technological forecasts or syntheses, and the choice-of-technology analyses.

Such documents contain little if any original scientific or technological information but a lot of useful facts and policy considerations about science and technology as an activity and development as an objective.

The number of titles and references in this category is much smaller than in scientific and technological information proper.

A large proportion of such documents is in typewritten form and not offered for sale by commercial publishers. Many of them can nevertheless be obtained on request at the headquarters of the editing institution (often public or non-profit) or at the author's address, though some are working papers with restricted distribution or access.

card files, or else provided on magnetic tape with remote on-line access and computerized selection from a terminal at the user's location.

The purpose of the more sophisticated means is to ensure a relative degree of completeness in the bibliographic search. An exhaustive search is not always needed, however; it is generally required mainly in research centres before a final decision is made on a new research programme, in order to avoid useless spending. It is also desired in industry where patenting is involved, with a view to avoiding litigation or errors in business strategy. However, many scientific units whose activities fall outside the two cases just mentioned are satisfied with bibliographic searches that claim no exhaustivity. This accounts for the fact that, even in industrialized countries, many scientists and engineers make little or no use of the more sophisticated means. Good libraries with lending and exchange services and with photocopy facilities are all that they currently use.

Nevertheless, access to electronic selection of titles in bibliographic data bases is considered a necessity in a growing number of disciplines where the annual number of new titles is already so great that the traditional means are less and less effective in searches.

Although the future will obviously lead to more general use of these services among groups which as yet do not feel an urgent need for them, it would be an error to focus exclusively on such services and to overlook the fact that improvements in library services may be the top priority for most users. In practice, a good library service is also the first step towards the effective use of sophisticated retrieval techniques.

Means of Access to Stored Information

Printed paper will for some time remain the dominant means of access to stored information. However, computer memory with on-line access is already preferred for consulting both hard data bases and bibliographic data bases because the user does not really need the table or the directory itself, but only a few selected lines. Another reason is that the magnetic table or list can be updated at very short intervals and at minimum cost, whereas updating is very costly for printed tables or directories and is often unduly postponed for this reason.

While some bibliographic data bases transmit only the title and reference on-line, abstracts and summaries of articles and documents and the tables of contents of books are already accessible on line in other cases. In the medium range, the decreasing cost of memory bits and of telecommunication time will lead to more general use of on-line transmission of texts describing contents. This allows the user to select the documents needed more accurately than he could do from their titles alone.

Later, as costs continue to decrease, a growing number of documents will become available on-line in their full length. As noted below, the European Economic Community now has a project called DOCDEL for document delivery on-line.

Non-scientific and Non-technological Information

Outside the field of science and technology, computerized data bases and data lines are also developing at a fast rate.

A large number of papers in this category would be of great interest to policy and planning officials but go unnoticed because they are not commercially distributed and consequently not recorded in the secondary information systems.

Newsletters and surveys restricted to subscribers

Some periodical documents accessible only by subscription are particularly expensive. This is the case when the price covers not only ordinary copyright, editing, printing, and mailing costs but also the full costs of a team of scientists whose function is to keep the subscriber informed of the latest developments in a specific field of advanced technology.

Patents

Description of patent rights and protected inventions is a form of scientific and technological information of major importance for industrial and commercial enterprises. Access to the description is often free or inexpensive.

Unpublished research reports and dissertations in stencil or typewritten form

These accumulate in universities and technical graduate schools, often with poor accessibility, though some of their contents are original or up-to-date scientific and technological information not to be found elsewhere. Their authors are often researchers in training or graduate students.

Information about ongoing research and development

Scientific and technological information books and reviews contain mainly the results of past research and development. Considering the delays in publishing many important reviews, information about the existence of a research project is delayed a number of years (often more than five years). Though most colleagues are informed in symposia or by other personal contacts, earlier information may be useful to the scientific community. A few systems have been established for the purpose of providing early information on ongoing research.

Unpublished proprietary information

Military, state, and business secrets fall into this category, which remains beyond the scope of any scientific and technological information system or network.

Information about Information (Secondary Literature and Data Bases)

A majority of researchers still use the most traditional means of locating the references to books, articles, and other documents where the information they need is to be found. The traditional means are personal contacts with colleagues, for which scientific symposia are essential, and bibliographies published in books and articles already at their disposal.

More sophisticated means include reference or reference-and-abstract books or periodicals, published on paper or on

Stock exchange rates, commercial information on firms, professional data and references, processed economic data, and general political or newspaper information constitute some of the main flows on the existing data networks. It is not advisable, for economic reasons, to separate science and technology systems from the general data networks and carrier lines.

From the recent European experience of the EURONET-DIANE network, a very clear conclusion is that the same lines, the same terminals, and the same "hosts" (in French, "serveurs") service the science and technology users and all other categories of users (mainly business, newspapers, government, and specifically interested segments of the public).

The present tendency is to provide general access to all computerized sources for every subscriber of an ordinary telephone line, if the latter augments his receiver by a personal computer acting as data terminal.

For long distance transmission of data packages on fast lines, the messages are condensed and tagged to be decondensed and reconstituted upon arrival, so that their speed of delivery remains that of the slow telephone lines (packet-switching technique).

Such techniques combine the use of existing slow telephone grids with high-speed long-distance data lines, the latter having higher capacity and lower unit cost per byte. The lines are provided by different technologies, to include satellites in the future. No scientific unit will have to wait for improvements or renewals of its local telephone grid before being connected to the world's network of data services. In many cases, science and technology work (unlike some businesses) does not require an upgrading of local lines for the transmission of its messages.

Concept of Global Scientific and Technological Network

The idea of global network of information should therefore not be considered in the literal or physical sense of an autonomous grid of telecommunications and hardware, but as an organizational concept: a union of co-operating agencies (worldwide, regional and national); public, NGO, and commercial; libraries, data bases, publishers, telecommunication carriers co-ordinating by adequate arrangements the full range of techniques from printed paper to on-line services with a view to providing effective access at minimum cost for the benefit of all scientific units in developed and developing countries.

If consensus is reached on the concept and the final purpose, the next step is to choose or rank the intermediate objectives in a sequence that makes sense and might serve as a backbone for a programme. A lot of brainstorming will be necessary before agreeing on such a sequence. Here is a first attempt, which does not prejudge in any way who pays for what since obviously the user's organization, his government, and the different forms of development aid will have to share the costs at different stages. Let us be descriptive in purely functional terms and leave the financing problem for later consideration.

We start from the assumption that each "unit" of users, down to a small group of scientists and engineers working together, is connected to a national telephone grid. We also assume that the members of the unit are normally both consumers and producers of scientific and technological information (both by reading and writing articles, books and the like).

The unit may be part of a larger establishment (university, school, centre) of which the members share the premises and the library services, if any. When we use the word "they," we refer both to the smaller unit and the parent establishment.

Stage one

At the starting point, "they" probably possess a stock of science and technology books and a number of collections of science and technology journals. Somebody acts as a librarian; registering, lending, calling back the books, and increasing the stock are his initial functions.

Stage two

If the "librarian" has made agreements with other libraries for mutual lending or has an entry to a larger scientific library which provides interlibrary lending and/or photocopy services, he will serve as an intermediary whenever one of his colleagues is looking for a book or review not to be found in their own stock. The librarian will advise his colleague and help him in his bibliographic searches, thus becoming a "documentalist". He will then enter "secondary literature" (abstracts) on his shelves.

Stage three

The librarian is in charge of obtaining the selected document if it is not present in his stock. Where can he borrow it from or get a photocopy?

Ideally, he would like to possess the catalog of the libraries with which he has lending agreements. He does it sometimes. But in most cases he will have to use the telephone to locate the documents. He will give preference to a library not too far away (in the same city, the same province, or the same country), but sometimes he will have to borrow the document or order a photocopy of it from the other side of the globe and incur the corresponding postal costs and delays.

It would be helpful for him to be able to consult a national catalog to make sure that the desired book or article is not available next door or on the next block, as sometimes happens. National catalog are often lacking, however, and not only in developing countries.

Stage four

The librarian (who may have other functions on the team and may or may not have been trained as a documentalist) convinces the unit or the institution to provide him with a terminal, connected to the telephone grid, in order to enable him to consult electronic data bases on-line. This stage is reached when the number of abstracts to be kept and filed on cards has outgrown the clerical manpower available in the library, and provided the connection is possible. The budget must also allow for expenditures in telecommunications and system dues.

It is to be noted that most personal computers can now serve as data terminals and are no longer expensive. They can also perform a number of other jobs in the library and in the unit. But it takes some training to "dialog" with a computer

and to select a useful bibliography from a distant database. Unfortunately, each systems has its own command procedure and classification basis and also its own semantics in keywords and concepts. The first attempts to install a Common Command Language (CCL) have proved successful in the framework of EURONET-DIANE. However, CCL is not yet generally used by all hosts.

If the scientific staff is multidisciplinary, the librarian will have to learn how to practice several of the systems. UNESCO/UNISIST and ISO are aiming at system standardization, but this will take a long time, by any measure.

Meanwhile the necessity of using a number of natural languages and also system languages is inescapable, and requires special training for the person who dialog with the computer. This trained person and his colleague, the user scientist or engineer, will have to keep close contact during the various steps of the selection dialog, because the user alone knows what he is seeking and the documentalist alone knows how to formulate the questions. The physical proximity of the two persons is essential.

Once the unit has been equipped with a terminal, it can also have access to hard-data bases or banks in its specialty and may also consult non-scientific and technological information services in videotex or other systems (business and economics, *inter alia*).

Projects exist also in the European Economic Community (namely, a project called DOCDEL) for on-line delivery of documents, a service that might in the not too distant future replace the mailing of photocopies and avoid the corresponding delays and costs, provided adequate copyright arrangements can be found.

Input to the bibliographic data bases

So far, "they" have attained a fair degree of access to the world's published scientific and technological information. But is their own scientific or technical production recorded and abstracted in the data bases most used?

This is by no means certain if they belong to a developing country whose contributions in science and technology are not yet as significant as they will be some day or whose journals are not printed mainly in English. Publishers of secondary literature easily overlook such contributions, although they can be of great importance to other developing countries which face the same problems in the use of science and technology for development.

At least in the scientific and technological data bases established in the United Nations system e.g. INIS of IAEA, AGRIS of FAO, an effort is made to provide exhaustive input of each country's scientific and technological literature in a particular field, through a national agency in the country (often the national library or a specialized research centre). National agencies should extend such coverage to all fields of science and technology, since it is an important right for every scientist in the world to have his production recorded in the most-used data bases.

Stage five

National structures and services

National authorities have a significant task in helping every institution or scientific unit to develop gradually to the fifth stage: entering more books and reviews in their own specialized stock; developing better interlibrary lending and photocopy services which requires at least one large scientific library in each country, as well as agreements with other countries; having a trained person and a connected terminal in each library (with on-line access to the national catalog and the world network).

For scientists and engineers who are not working in a science and technology unit or in an institution (as consultants or professionals) or who are working with a small enterprise, the national network can be complemented by local scientific and technological information centres or services, preferably established and run by the professions themselves on a non-profit or co-operative basis. Such institutions would have a terminal and a trained documentalist to help their members as long as they have no terminal and no training themselves.

Except for input function and the national catalog we have so far described no specific duty for a national focal point. Member countries of the European Economic Community (EEC) have established national focal points in the fields of agricultural, environmental and biomedical information, where special problems exist. However, generally speaking, it is not advisable to establish a big national documentation centre to centralize nationwide bibliographic searches, since close personal contact on the spot between the user and the trained documentalist is a necessity during the documentalist's dialogue with the computer. Such personal contact is feasible only by spreading the terminals throughout the country.

National services, should be ancillary to widely spread self-service terminals; any form of monopoly of access to the world network would carry with it the dangers of remoteness, slowness, obtrusiveness, inefficiency, and finally poor records of effective use.

New information sources provided by a World Network

Worldwide bibliographic data bases, as noted above, have already been established by non-governmental organizations, by private publishers, and by United Nations agencies such as INIS of IAEA, and AGRIS of FAO, or other intergovernmental bodies. The coverage, though already extensive, still contains a few gaps. Improvements in the manner of dealing with the interests and concerns of the developing countries are also necessary.

It is not impossible that an inquiry would motivate initiatives. It is more likely, however, that it would lead to a few extensions and improvements in the coverage of existing systems. It might also lead to restructuring some of the systems already established in the United Nations system, which could far better if they were distributed world-wide in a communication network designed along the concepts of the European DIANE network (a network for all kinds of data bases, not just scientific and technological information).

The idea of merging existing bibliographic bases in a single system covering all disciplines will find little support. The possible advantages (less overlapping, easier searches in borderline disciplines) are few in comparison with the difficulties and the negative aspects (high costs, rigidity, lack of practical feasibility, hampered creativity).

"Grey literature" documents, though less adequately recorded and distributed, are important for a number of civil

servants and managers in each country, even though the persons concerned and titles are much fewer in number than for scientific and technological information proper as noted above.

It would be a sensible form of intergovernmental co-operation in science policy and development strategies, to try to improve both the availability and the circulation of many reports often very valuable that have been paid for by taxpayers but lie buried in the basements of ministries or agencies. With SIGLE, the on-line information system for the so-called "grey literature," the EEC attempts to fill this gap and to provide information in this category to potential users. Better recording might also be provided for students' reports which also rest unused in the basements of universities.

National Financing and Foreign Aid

Potential users of scientific and technological information whose budgets are severely limited (often including educational, institutional, public and non-profit research and development centres, and small enterprises) will not easily attain the fourth stage of development without receiving some aid to buy more books, subscribe to more reviews, train documentalists, and pay system and telecommunications dues. Foreign aid for such users complement the national effort. Preferential terms for them may also be set by the national or local telephone grids.

Negotiating Dues and Fees in a World Network

It is common for public service desiring to enlarge its turnover or its market to arrange special conditions for categories of users that cannot contribute financially to the full cost of the service. Existing news and scientific and technological information systems with an already established clientele in the affluent categories of the industrialized countries might consider it worth while to extend their systems to the "poorer" sectors of developing countries by reducing fees or dues. One of the conditions might be that the telecommunication carriers would also reduce rates correspondingly, not only for the fast data lines, but also the national grid. The absence of proportionality to distance ("distance independence") in EURONET dues proved a sure way of encouraging intensive use of existing sources and systems and of equalizing the right of access to information, irrespective of location. This example may appeal to many developing countries, considering that many data bases and their "hosts" are concentrated in the North.

The world network may be envisaged as a useful forum and board of managers to negotiate the best possible conditions for a large number of potential users in developing countries that have limited resources.

Language Problems

A majority of the books and articles destined for the scientific community are written in one of the few languages of widespread use in science. The situation is already different in applied science and technology where a document must reach a large public of technicians and operating agents who cannot read foreign languages; such documents are printed in the language of the country, notwithstanding the universal interest of their contents. Industrial and agricultural information at the applied and practical level is of primary importance and of common concern in the use of science and technology for development.

The use of national languages is also predominant in socio-economic and legal literature, when the publisher's target readership is mainly national, which is often the case.

When the user has to consider the cost of translating a document from a foreign language, it is of primary importance, in order to minimize such cost (a) that he be informed of any translation previously made, either for publication or for international use, anywhere in the world, since in many cases he would get a courtesy copy of it if he only knew whom he might ask; and (b) that he be certain, if he finds that no translation has been made, that the document really contains the information he needs.

The first requirement calls for on-line data bases containing information about existing translations (using the ISBN and ISSN numbers and any supplementing number for identifying the original document). Among these who do "translation spotting", I.T.C. Delft deserves mention.

The second requirement calls for a more systematic translation of titles and abstracts, at least in the four or five languages that are used by a large number of countries.

It is only by means of agreements with countries and with publishers of primary and of secondary literature that the burden of translating the abstracts can be appropriately shared and their distribution gradually broadened.

If the rule is accepted that the publisher of the primary document should include in the document itself an abstract (drafted in conformity with ISO directions) in two United Nations languages, an important first step would be accomplished. From then on, a condition to be met for any data base to be distributed on the world scientific and technological information network (at rates to be agreed with the carriers) would be the provisions of titles and on-line abstracts in at least two United Nations languages (for new titles).

A third (and possibly a fourth) United Nations languages could be negotiated as soon as the first stage proved its practical value.

As the translation and distribution of abstracts in a language currently used by only one country or by a small number of countries, it would be the task of the interested countries either to seek translation and distribution arrangements with the publishers of secondary information, with data bases, and with the world network, or else to provide the services themselves to the users of that language.

The current research programmes of the European Economic Community in automatic translation contain the promise of important breakthroughs in dealing with language obstacles. EURODICAUTOM is a multilingual terminology data bank of specialized terms, to be consulted on-line.

The use of SYSTRAM (an automatic translation system) and of a more advanced system to be developed through the EUROTRA research project may prove helpful either for translating an entire bibliographic data base or for providing the user, on request and on-line, with an ad hoc translation of the abstracts of titles already retrieved. The service might prove helpful to other countries, too.

Co-operation of the Global Scientific and Technological Information Network with Exclusively National Information Systems

Legal matters, economic and business facts, and statistics are on the borderline between scientific and technological information and non-scientific and non-technological information.

In the natural sciences and in technology, parallel development of more than one national bibliographic data base would be wasteful because the literature itself has a mainly international audience. Books and articles of foreign origin would be predominant in each data base and the duplication of efforts and costs could not be avoided.

However, the readers of documents dealing with legal matters, with socio-economic subjects, or with statistics and with the reporting of national facts and concerns often are predominantly nationals; and this sometimes justifies the use of national systems, to be run under either private or public ownership, according to the circumstances.

Once connected by a terminal, scientific units have access (and sometimes need access) to both the national and the international data bases. In the DIANE concept, this apparently poses no problem, and facilitates co-operation with the world network in matters such as technical definitions, semantics, and keywords. Such co-operation is highly desirable. It could also take place in the UNISIST framework.

Conclusions

1. Books, journals, interlibrary lending, and photocopy services are still the basis of scientific and technological information, and every plan for improving the situation in developing countries should take full account of this starting point. Personal contacts play also a major role in scientific and technological information.

2. The next step for a scientific unit or institution is a terminal providing on-line access to several computerized bibliographic data bases and to a national catalog. This implies that at least one person in the staff has to be trained for the job.

3. The terminal opens the door also to consulting all non-scientific and non-technological information data bases (business and others) and to all present forms of electronic editions, including VIDEOTEX. The same hardware also connects the scientific unit with hard data bases, whenever they exist in its specialty.

However, with the exception of cases where connection with hard data bases is top priority, the need for a terminal will not be felt where there are no adequate interlibrary lending and photocopy services.

4. European experience drawn from EURONET-DIANE is that widely spread terminals using existing grid lines is the best way to bring service without delay to a large number of users. This is not technically incompatible with fast, low-cost long-distance data lines (through packet-switching techniques).

Network arrangements should carry both scientific and technological information and non-scientific and non-technological information services on the same hardware, for reasons of cost. Future developments for on-line delivery of documents may contribute to this goal. The APOLLO project for satellite transmission (planned jointly by ESA and the EEC) is expected to reduce rates considerably.

Referral centres ("hosts") help the user in establishing the computer dialogue with any data base on the system. The distance between the user and the host does not matter if the rates are not based on distance. Wherever possible, proportionality to distance should be avoided. The rates can rest on different bases and be charged for accordingly, though some standard practice is desirable.

5. The same services can be extended to developing countries without major technical difficulties. This would lead to a global scientific and technological information network concept not related to hardware (computers) or to any centralization of service, but consisting of a forum for co-operation and a board of managers. Its aim would be the improvement of existing systems to meet the requirements of developing countries, as well as new initiatives. One of its tasks would be to seek arrangements for favourable conditions of access for scientists and engineers in developing countries.

6. In this concept, the role of national governments and their "focal points" is to help establish the basis and the conditions for wide-spread and decentralized use of the system's services throughout the country. It should also provide a national catalog to ensure fuller use of documents already present in the country and to minimize the need for international lending and photocopy services.

Problems and Prospects of Networking in Technological Information in Asia and the Pacific

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Introduction

There are many technology agencies in Asia and the Pacific that collect, assess, and disseminate technology information serving national, sub-regional, regional, and international uses. The level of techno-banking varies from elementary or non-existent systems for developing island countries in the South Pacific, adequate systems for the newly industrialised ASEAN countries, to large sophisticated computerized systems for the more industrialised countries such as Australia, Hong Kong, Japan, Korea, New Zealand, and Singapore.

Techno-banking is usually undertaken on a sectoral basis by agencies mandated to work on the development of a particular sector. For food processing, for example, information could be obtained from the Division of Food Research of the Commonwealth Scientific Industrial Research Organization of Australia, the Food Technology Research Institute of Indonesia, the Institute of Nutrition Sciences and Food Technology of Iran, and the Nutrition Research Institute of the Philippines. Food related departments of universities in these countries also provide information.

For techno-banking covering wide range of sectors, not many institutions in the region are organized for such a task. Among the techno-banks covering many sectors are the Institute of Scientific and Technical Information Centre for Science and Technical Information of China, the Hong Kong Productivity Centre, the Japan Information Centre for Science and Technology, the Technology Resource Centre of the Philippines, the Pakistan Scientific and Technological Information Centre and the Singapore Institute of Standards and Industrial Research.

Information on various sectors is also available from major research and development institutions and technology transfer/promotion centres such as the National Research Development Corporation of India, APCTT, Korea Technology Advancement Corporation and Korea Advanced Institute of Science and Technology, and the Pakistan Council of Scientific and Industrial Research. Queries can also be addressed to the main science and technology agency in a country such as Bangladesh Council of Scientific and Industrial Research; Central Research Organization of Burma; Council of Scientific and Industrial Research of India; Department of Scientific and Industrial Research of New Zealand; and Ministry of Science, Technology and Energy of Thailand. In this case the detailed reply is likely to come from the appropriate specialized technical agency under its umbrella.

Subregional technology information exchange is handled by subregional organizations or networks and by national agencies assigned by subregional task. Information on technologies appropriate to the South Pacific, for example, is being collected and disseminated by the South Pacific Commission, South Pacific Economic Bureau, and South Pacific Appropriate Technology Foundation. In the ASEAN countries, various entities provide information: ASEAN Association for Planning and Housing for housing; ASEAN Food Handling Bureau for food packaging; Southeast Asia Fisheries Development Centre for aquaculture; Southeast Asia Iron and Steel Institute for steel; and national institutions of learning assigned a subregional responsibility, such as the University of the Philippines for agriculture; Mahidol University (Thailand) for medicine, and Bogor Bio-Tropical Institute (Indonesia) for biology.

Region-wide exchange of technology information is carried out by regional institutions or networks and by national institutions mandated to provide regional services. Among the regional institutions and networks are the Asian and Pacific Coconut Community (coconut), Asia-Pacific Pepper Community (pepper), Technonet Asia (small industries), Asia Electronics Union (electronics), Asian and Pacific Regional Research and Training Centre for small Hydro Power (mini-hydro), Asian Productivity Organization (productivity), Food and Fertilizer Technology Centre for Asia and the Pacific (food and fertiliser), Approtech Asia (appropriate technologies), Centre for Integrated Rural Development for Asia and the Pacific (rural development), and the United Nations Asia Pacific Centre for Technology Transfer (agro-industries, biotechnology and genetic engineering, low-cost construction, microprocessors, primemovers and renewable energy). National institutions serving the region include the Directorate of Housing Research in Indonesia and the Central Building Research Institute in India for housing research.

Promoting the sharing of international technology information is done by international institutions based in the region and by regional and national agencies with such a responsibility. Among the international institutions are the International Rice Research Institute and the International Centre for Living Aquatic Resources Management, which are both located in the Philippines; the international Crops Research Institute for the Semi-Arid Tropics in India; and the

United Nations University in Japan. The Asian Institute of Technology which is a regional institution, maintains, among others, an international information network on renewable energy and ferrocement. As for national institutions, the Commonwealth Scientific and Industrial Research Organization of Australia is assigned to maintain a network of technology informations on renewable energy for Commonwealth countries while the Central Food Technology Research Institute of India services information needs on food processing for the United Nations University system.

Information on sources of technology information in Asia and the Pacific can be found in directories and trade periodicals of various organizations such as chambers of commerce, manufacturers associations, government and non-governmental organizations networks, and trade department directories of exporters. Even the yellow page section of telephone directories provides a quick scan of the level of technology of the sectors in a country. Ironically, information on sources of technology is generally not well compiled and disseminated by government technology agencies. Such information is more readily available from trade sources rather that from technology agencies.

The Compendium of Government and Non-government Organization Sources of Technology in Asia and the Pacific published by APCTT in 1983, provides valuable information on the agencies' products, processes, equipment, consultancies and research and development activities that pertain to APCTT's earlier priority areas: food, electronics, leather, low-cost construction, medicinal and aromatic plant products, the metals industry, renewable energy, sponge iron, and waste utilization. While providing background information for networking, APCTT realizes that the government agencies, which are usually tapped for technology information networking by international organizations, are not the major depository of information on technologies for immediate utilization in the region. The few exceptions would be the Japan Information Centre for Science and Technology, the Korea Institute of Industrial Economics and Technology, the Hong Kong Productivity Centre and a few other which have their ears to market trends and are closely linked to firms, entrepreneurs and venture capitalists. Most of the information on commercially applicable technologies is to be found in the private sector. Thus, APCTT's thrust in collecting information is to get more information on technical details and terms of technology transfer from the private sector. In addition, APCTT is undertaking a Technology Atlas project that periodically measures the national technological capabilities and needs of countries in selected areas and covers the technological capabilities and needs of the private sector.

The following discussion of technology information will be limited mainly to government technology agencies, agencies, referred to henceforth as "agencies."

Purpose of Promoting Technology Information

Technology information should, among other things, assist the enduser in finding new technical information; in locating suppliers of technology, technical assistance, machinery and equipment; in evaluating techno-economic aspects of a venture; in making investment decisions, in starting new ventures or diversifying production; in modifying or increasing efficiency; and in expanding the market. To support the efforts in improving social and economic conditions, technology information should help open new opportunities for job creation, income generation, and the provision of better services. All these can be done if information is utilized at the first stages.

The driving force for agencies, if they are to play a significant role in accelerating technology development and transfer, is to effect the immediate utilization of technology information. If not used, technology information or the technology itself, is as valueless as are many of the "appropriate" and commercially applicable technologies that are not utilized for one reason or another.

Weakness in orientation

If technology is to be brought to the here and now, a certain orientation is required of the agencies as described below:

1. The agencies should concentrate on collecting and disseminating information on technologies for immediate utilization. For the nonmarket or backyard economy (e.g., crops, energy), the information would cover those technologies referred to as "appropriate", "village" or "people's" technologies while for the market economy, information would deal with commercially applicable technologies or those which have proven their economic and technical viability and market acceptability. Except for competitors in export or enterprises opening up new export fields who would have considerable interest in trends in research and development and patents, most of the end users, such as firms, entrepreneurs, venture capitalists, technology venture syndicators, and consumers, are looking for specific available products and processes that can improve their production or open new markets. Such a specific requirement can be met only by information on commercially applicable technologies. Unfortunately, most agencies, perhaps because of the prevalence in their ranks of the scientist rather than technologist type in their ranks, concentrate their information collection and dissemination on research and development rather than on commercially applicable technologies. As a consequence, the agencies are hardly utilized by industrial end users.

2. The agencies should develop a dynamic and synergistic interaction with a broad base of sources, communicators, and users of technology in the public and private sector; which is crucial in bringing about the immediate utilization of information. Sources are government and non-government scientific and technological organizations, industry and trade agencies, firms, inventors, and techno-banks. Communicators are the mass media, trade and technology exhibitions, commercial and manufacturers' associations, financial institutions, technology venture syndicators and extension service agencies. Users would range from government and non-government scientific and technological organizations, firms, and entrepreneurs to consumers. In this regard, the agencies limit their contacts mainly to sources and gravitate around agencies with a similar research and development orientation. The net effect is that not only are agencies unable to link effectively with the demand side because they are out of touch with the communicators and users, but they end up storing information on research and development which is of little interest to most end users.

3. Agencies disseminating information on commercially applicable technologies should package the information in a manner attractive to endusers: it should be simple, current, and if possible, entertaining. Because of a combination of

budgetary constraints and lack of imagination and creativity, many agencies package the information in a substandard form which, taken at facevalue, tends to reduce the worth of the information. In contrast, embassy trade attaches put out glossy information packages which are used regularly by newspapers in the region, not because the technologies involved are equal or significantly superior to counterparts in the region but mainly because their presentation is effective.

4. Agencies have to be "heard, seen and appreciated". There is no point in developing a "super" product which is not known and appreciated by the consumers. In terms of institutional viability, agencies should project their corporate identity, offer unique service or comparative advantage, and gain credibility in servicing the needs of clients. Taking the communications approach, they should reach both general and specific target clients through various mass media and extension service techniques as for example "Techno-Tips" for broadcast media, "World-Tech" features for newspapers, technology fair on wheels, etc. From the viewpoint of marketing, the agencies should have suitable and imaginative packaging, pricing, and promotion of their product. On this count many of the agencies are hardly heard or seen and therefore not appreciated by endusers. For example, APCTT still received frequent queries from entrepreneurs throughout the region, although the information they are seeking is available right in their own backyard.

5. Corollary to the previous observations, agencies should work harder to cultivate, expand, and link to the demand side. More effort is required on this in the East as compared to the West because the "technology culture", which acknowledges technology as crucial to advancement and hence triggers the public to seek information on technology is still weak in the East. In this connection, perhaps because of the predominance of documentalists and information experts who are oriented towards supply side, agencies tend to put more effort on how to expand and organize the supply side. This orientation is based on the assumption that a good supply side will naturally flow to the demand side, which is not the case.

Because of this orientation, many discussions and project proposals on technology information tend to focus on supply-side matters: standardization of documentation, computerization, networking via telexes and satellites. Looking only at the supply side, the above proposals may seem (given the scarce resource reality of the region) to probably be the right ideas for the right place, but at the wrong time. Why worry about documentation when there is not enough material to document? Why go through costly computerization if there is not enough demand for the computer-based information? (For prestige purposes, one agency bought a mainframe computer for which the volume of work could hardly fill the shift.) Moreover, how can one, with some peace of mind, install computers in places where there are constant cuts in power and wide power fluctuations, and where the telephone line cannot even link one phone to another phone across the room? Why speed up transmissions via costly telexes and satellites when entrepreneurs in the region are in no hurry to make decisions?

The more fundamental question is, Of what use is a good supply side if it is not utilized by the demand side? In this connection, lessons could be learned from APCTT's experience. In 1982, APCTT averaged only from 8 to 12 technical queries a month. In 1983, it serviced close to 2,000 technical queries, involving some 500 technologies, a 20-fold increase from its volume of queries in 1982. This big jump was attained mainly by developing the demand side through mass media packages. RCTT felt that organizing the supply side is a routine and mechanical task that can be done by a team of librarians, documentalists and computer specialists. Organizing the demand side on the other hand, is more of a problem. Thus, it devoted extra efforts to developing the demand side and then worked back to the supply side.

6. With science and technology remaining vague and esoteric to most people, especially policy-makers, agencies require the political support of the national leadership if they are to go forward. The Korea Institute of Industrial Economics and Technology (KIET) is an example of an agency receiving such support. In 1982, KIET generated revenue by servicing some 200,000 queries. Despite the volume, it still required government subsidy to cover 25 to 50 percent of the cost of servicing the queries. The subsidy is being provided because of the confidence of the national leadership in the usefulness of KIET in supporting the country's technology development programme.

Except for agencies in countries like Hong Kong, Japan, and Singapore, many of the agencies still lack the political support of the national leadership. There could be a reason for this lukewarm response from the national leadership since these agencies have yet to prove themselves as capable of being heard, seen, and appreciated by end users.

Problems of networking

The term "networking" has been and still is in vogue in various attemps to foster bilateral and multilateral co-operation and in rationalizing many regional development projects. Despite its seeming theoretical soundness and the regular exhortation for its use in various forums and science and technology accords, networking remains elusive.

The application of networking to technology information assumes that it will speed up technology information exchange in an efficient manner.

To do networking with the agencies in their current state will not result in the immediate utilization of technology information. Based on the aforementioned observations of their weaknesses, what is required first is a change in their orientation. This can be achieved not through networking but through the infusion of new ideas, personnel, institutional arrangements and political will. For instance, to make agencies more sensitive to the needs of industries, the private sector should be given a stronger voice or an equal partnership in deciding the scope and direction of technology information. In order to be heard, seen, and appreciated, agencies require the services of marketing and communications people, imaginative use of mass media for disseminating technology information, and Madison Avenue and grass-roots techniques in public relations and advertisement. In the present state of the agencies, networking them would only imprison them in a vicious circle of exchanging ideas and experiences to organize better a supply of information which is of little interest to end users.

Assuming that the agencies can outgrow their current orientation and be more market-oriented, there will still be problems in networking.

The foundation of networking is transaction, ideally, confident, and mutually beneficial transaction. Networking with-

out transaction is meaningless. On the other hand, where there is confidence and there are perceived benefits, transactions will flourish even without a networking arrangement. Having developed a good working relationship based on confidence and perceived mutual benefits, APCTT is able to deal regularly with agencies and the private sector in servicing queries without the benefit of a networking arrangement.

In this connection, it appears that the agencies do not yet sufficiently interact with each other. They do not maintain a regular contact by assisting each other in servicing technical queries. Their contacts are limited to expensive but rare meetings, the exchange of periodicals (which is done as a matter of course) and, in the case of ASEAN, through multilateral programmes. It may be stressed that most of the agencies have good-will and are eager to co-operate, if asked. That they do not interact regularly might arise from their not having anything much to transact with each other or their not knowing what they could do for each other.

In cases where there is transaction, agencies are hampered by the lack of resources to carry out their networking responsibilities. To begin with, many agencies lack the resources just for their own domestic operation. In many instances, the agencies do not have access to information from other agencies because they do not have funds to cover the cost of documentation and mailing. To translate Korean, Chinese, and Japanese documents into English, for example would cost a minimum of $US 10 per page. Not many agencies have the funds, much less the facility to get a permit for foreign currency for this purpose. A way out is to have a bilateral agreement between agencies to translate for each other. Even this is not easy to implement, as the agencies lack manpower. In a case involving two agencies from two countries, an agreement to help each other translate technical literature ceased to be implemented after the first translation, as it took one party six months to complete it.

Going to the modality to networking, the practice of designating a national node, as favoured by international organizations, could work when dealing mainly with the policy aspects of technology information. The main government science and technology agency and a counterpart from the private sector could be tapped as national nodes for this purpose.

However, for the purpose of having a wider scope and freer exchange of technology information, designating a national node may not be productive. Because of the usual bureaucratic deficiencies and inter-agency frictions, a government national node may not be able to get full co-operation from other agencies in collecting and presenting information within the country, much less, in speeding up the exchange of information. A counterpart national node from the private sector, except when sanctioned by the commerce and manufacturers' associations, might be suspected of using the technology information exchange only for itself. A more pragmatic approach is to include as many interested parties as appropriate from the public and private sector, in sectoral networks.

Input of United Nations agencies

Discounting the loans of the World Bank to technology-related projects, the United Nations family spent at least $US 1.4 billion in 1984 for technical assistance. Many of these inputs dealt with technology development. The contribution of the United Nations family is well documented in books (e.g., a book on the World Bank's role is accelerating technology development) and in numerous reports of the United Nations agencies. The technical content of the various United Nations inputs is abstracted regularly in **Development** which is prepared and distributed by the United Nations Department of International and Economic Affairs.

Unfortunately, APCTT's experience shows that it has not been able to use much of United Nations material except that from technologically oriented agencies such as UNIDO and WIPO, in servicing technical queries. The problem is simple: the United Nations reporting including the abstracts in **Development** does not detail the technical content of the United Nations inputs. The United Nations expert's report may identify the officials met and describe in general terms the innovations introduced but does not specify in detail the technology involved. In this regard, for example, UNDP, which funds many of the technical projects, might consider adding another page in the six-monthly report of projects specifying technologies that have been involved in the project in terms of products, process, equipment, consultancy, and research and development.

Another problem observed of United Nations inputs is a preoccupation with the supply side of technology information, how to develop manpower for documentation, computerisation, and the like. United Nations agencies would have greater impact if they devoted equal attention to the demand side, more specifically, on promoting and disseminating technology information.

Recommendations for networking

The following recommendations are being made on the premise that the agencies must first change their orientation to be more responsive to the end users.

To promote networking, here are some measures that could be considered.

1. Agencies should be encouraged to transact with each other more regularly. In this effort, international technology agencies, serving as brokers, could refer queries to the agencies so as to build their confidence and their perceived benefits from the transactions.

2. Additional budgetary resources, both from within and from without, should be made available to carry out the networking responsibilities.

3. Once agencies begin to transact regularly, then networking can be formalized by written agreement.

4. The designation of national node from the public and the private sector, respectively, for networking could be pursued, mainly for setting policy direction in technology information.

5. For a wider scope and freer exchange of information through networking, membership should be open to as many of the appropriate parties in the public and private sector as possible.

6. United Nations agencies can help in networking by recording the technology content of United Nations intervention in a format useful to entrepreneurs, and by addressing programmes to the demand side through the promotion and dissemination of technology information.

PART SIX:

Experiences of the Organizations of the United Nations System and Other Institutions

Existing and Planned Information Systems and Services of the Organizations of the United Nations System

Centre for Science and Technology for Development
United Nations, New York

Introduction

The Vienna Programme of Action recommended the restructuring of the international scientific and technological information systems with the aim of making them more accessible to developing countries. As an essential step in these changes, the establishment of a global network of scientific and technological information was recommended. This network should provide access to information for users who contribute to problem-solving activities and decisions relating to development.

The global network is not meant to replace any of the existing or planned UN system's sectoral, national, regional or international information systems and services, but should rather be viewed as a means of strengthening them and providing, through a shared knowledge of the operations of all participating organizations, the means for their intercommunication and linkage. It should be hospitable to a variety of scientific and technical information sources and services, the extent of which would be determined by user requirements.

The Task Force on Science and Technology for Development of the Administrative Committee on Co-ordination has approved a set of five joint activities intended to contribute towards the establishment of a global network of scientific and technological information. These five joint activities were part of twenty-four approved by the Task Force in response to Intergovernmental Committee resolution 2(III) of 5 June 1981 on the Operational Plan for the implementation of the Vienna Programme of Action.

The five joint activities were as follows:

(i) National nodes for the Global Network of Scientific and Technological Information.

(ii) Directory of major information services in science and technology.

(iii) International standards for information handling in support of the establishment of the Global Network of Scientific and Technological Information.

(iv) Development and use of indexing vocabularies and other terminological tools in support of the establishment of the Global Network of Scientific and Technological Information.

Members of the Task Force, in approving these five activities, agreed that the referral services of the global network should be established first and that other functions could only be considered at a later stage. The Vienna Programme of Action also clearly emphasizes that the global network should direct users to the right sources of information, that is, a referral service that would provide information-on-information.

It may also be recalled that the Intergovernmental Committee, in its decision 12(V) of 17 June 1983, requested the Centre for Science and Technology for Development, in co-operation with the ACSTD, the ACC Task Force on Science and Technology for Development and other intergovernmental institutions in the field of scientific and technical information, to prepare a study on the long-term plan of action for the establishment of the global scientific and technological information network to be submitted to the Committee at its seventh session in May/June 1985. In the same decision, the Intergovernmental Committee encouraged the United Nations organizations to continue their work in strengthening or establishing national scientific and technological information systems and invited the Task Force to review the joint activities on scientific and technological information in the light of the study.

Since all the scientific and technological information systems and services of the organizations of the United Nations system are expected to be part of the network, the following short review of their existing and planned scientific and technical information activities are provided in order to better inform the Intergovernmental Committee.

Scientific and Technical Information Systems and Services of the Organizations of the United Nations System

Many organizational entities within the United Nations system have, or are planning to have an information service or system, which has been, or will be, developed either as managerial support mainly for internal purposes of the organizations or as international or regional information system or service oriented towards needs in Member States. A brief overview of the major activities of the different entities with special focus on scientific and technical information is given below.

United Nations

DHL/UNBIS (Dag Hammarskjöld Library/United Nations Bibliographic Information System)

UNBIS is an on-line bibliographic and factual information system operated by the Dag Hammarskjold Library at United Nations Headquarters. UNBIS identifies publications, pro-

viding full bibliographic information for each; indexes this information in full subject, author and factual detail; and provides users with printed catalogues and on-line services of this information. About 25% of the bibliographic citations covers scientific and technological documentation.

Also included in the UNBIS system are bibliographic records of materials recently acquired by the Dag Hammarskjold Library. This provides access to a broad range of materials relevant to the work programme of the United Nations, as well as the most extensive coverage available of what is being published about the United Nations in the world press.

In addition, UNBIS provides factual information about the proceedings of the deliberated organs of the United Nations including records of votes taken in the General Assembly, full text of General Assembly and Security Council resolution, and information on speeches made before the organs.

There are a total of 10 data bases which comprise the system. The system has joint co-operative efforts not only with the Library of the United Nations Office in Geneva, but with various departments and offices at Headquarters and throughout the United Nations system of organizations.

The principal users of UNBIS are the staff of the United Nations secretariat and delegations of Member States.

PSCA/Outer Space (Department of Political and Security Council Affairs)

Outer Space/ISIS is an information service, in its planning stages, intended to serve as a central location where Member States and other interested parties could obtain adequate and up-to-date information regarding ongoing activities in different aspects of space science and technology. Since the areas of meteorology and communications are currently well covered by WMO and ITU, the initial efforts of this service would focus on remote sensing technology.

In 1985, a directory of space information and data services would be published. This directory would provide information on training, research and fellowship opportunities in different aspects of space science and technology. Efforts would be undertaken to provide a similar directory on equipment, data and literature in 1986.

On a long-term basis, it is anticipated that this service would have an on-line (dial-up telephone network) transaction processing systems, using remote terminals in order to undertake bibliographic search on scientific publications, reports, brochures, etc. In addition to the terminal being used to perform many other functions, it is anticipated that it could be used to provide and deliver necessary bibliographic information, on request, to users in the developing countries.

DIESA (Department of International Economic and Social Affairs)

DIESA/DIS is a computerized bibliographic information storage and retrieval system designed to give rapid access to unpublished working papers, studies, mission reports and project reports prepared for DIESA, DTCD, the United Nations Financing System for Science and Technology for Development and the Centre for Human Settlements. It provides on-line search on request as well as document delivery. It distributes a bi-monthly journal called "Development Information Abstract" and produces retrospective bibliographies. Its use is free of charge and restricted to governments, United Nations systems, intergovernmental organizations, nongovernmental organizations and non-profit-making organizations.

UNCTC (United Nations Centre on Transnational Corporations)

The CTC/CPS (Corporate Profile System) is a computerized data base covering, *inter alia*, foreign investment legislation, direct foreign investment, corrupt practices, restrictive business practices, activities of transnational corporations, industries, technology transfer, and accounting and reporting. The system covers the following services: library, bibliographic, referral, clearinghouse, information analysis and data bank. It provides on-line searches on request. Access is restricted to governments, and to the United Nations free of charge, and to others by special arrangement. Sixty per cent of the users are from developing countries. In 1983, 121 requests for information were received.

ECLAC (Economic Commission for Latin America and the Caribbean)

CLADES is a decentralized information programme in which the institution does not process all the information generated in the region but instead, promotes, co-ordinates and provides technical support for action conducive to the establishment of national centres by sector, discipline or mission to control, process and transmit the socio-economic information produced in the respective countries.

In the CLADES Programme documents are analyzed, condensed, indexed and processed on a computer using the ISIS software system. The work of CLADES consists mainly of the formulation of diagnosis methodology, proposals of alternative solutions, the provision of training for the human resources required and supervision of the establishment and entry into operation of the information system selected for various regional or subregional projects. In this sense, CLADES operates as a resource centre assisting a number of institutions in the region. From the dissemination point of view, CLADES has organized a publication programme for disseminating information on its plans and programmes, indexing results and summary of documents, instruments of co-ordination and communication, tools for standardization of analysis, analysis methodologies in the design of inventories, formulation of projects etc. Within the ambit of CLADES, a project called INFOPLAN is under way for establishing a system of information for co-operation in planning in Latin America and the Caribbean as a basic component of co-operation and co-ordination among the planning organizations in the region. ECLAC also has a data base, BIBLOS, a bibliographic data base on industrial development and hydric resources. The data base is used, mostly by ECLAC staff, for the preparation of reports and project proposals for the region.

ECA (Economic Commission for Africa)

ECA/PADIS is a bibliographic system which has been in operation since 1981. Its objectives are: to create an African data base containing reference to information on African economic, social, scientific and technological development; to assist Member States of ECA in strengthening or establishing national infrastructure in order to enable them to partici-

pate in the network; and to provide technical advisory assistance and training to Member States. When fully operational, PADIS is envisaged to be a co-ordinated network of collaborating national and subregional information systems or participating centres linked to a data bank in Addis Ababa by a satellite communications network. PADIS is multi-disciplinary in scope and will establish effective linkages with international information networks and data bases.

ESCAP (Economic and Social Commission for Asia and the Pacific)

ESCAP plans to set up DEPLADIS. The basic principles underlying DEPLADIS are the following:

(i) It will be an evolutionary system growing under the pressure of a long-term nature for documents information on development planning arising primarily from the ESCAP countries and the various divisions of ESCAP Headquarters and secondarily, in the long term, from other UN organizations and information systems.

(ii) It will utilize all the existing United Nations systems having information on development planning to the maximum extent possible consistent with its information demand pattern. Toward this end, it will:

(a) Serve as a focal point and clearinghouse for information on development planning emanating from the ESCAP region;

(b) Serve as a receiver of information on a regional co-ordination basis from other UN information systems;

(c) serve as regional feeder to other UN information systems regarding Documents Information on Development Planning in the ESCAP countries.

(iii) It will concern itself as much with the exercising of professional competence, knowledge, experience and intuition for the selection and processing of raw documents and document information received as with the mechanical storage and dissemination of the documents and documents information.

DEPLADIS is proposed to be developed into a network connecting the various ESCAP countries principally utilizing the geo-stationary satellites. An important input to DEPLADIS is the Science and Technology Documents of relevance to development and development planning. Science and technology input is considered as an essential component of the development process and as such, the documents data base is planned to have a separate science and technology sub-data base. DEPLADIS will be developed first by strengthening the national systems followed up by the nucleation and growth of subregional systems which will be connected at a later date to form the ESCAP Development Information Network. One such subregional system called RINSCA (Regional Information Network for South and Central Asia) is already in an advanced stage of planning and in a preliminary stage of implementation.

In addition, ESCAP/RCTT maintains a data base and provides services covering commerciable technologies on agro-industries, electronics, renewable energy, metals industry, low-cost construction and waste utilization. Entrepreneurs and firms form 95% of the users of RCTT information services. In 1983, almost 2,000 queries were received and answered.

UNIDO (United Nations Industrial Development Organization)

UNIDO operates two major information systems, namely INTIB and TIES. INTIB has two sub-systems, INDIS and LINK. INDIS is bibliographic and covers information generated by UNIDO such as meetings, missions, terminal reports, as well as United Nations sales publications. About 60% of the users of the service are from developing countries. Over the past three years, they have provided services, on the average, to 10,000 users annually. LINK covers information on institutions, technology suppliers, etc. Users comprise 75% from developing countries and 10% from developed countries. In 1983, there were 1,300 industrial inquiries and 200 publication requests.

UNIDO's and TIES provides information on the terms and conditions of technology contracts approved by government agencies available among developing countries on the basis of reciprocity and fosters co-operation among technology transfer registries.

UNEP (United Nations Environment Programme)

UNEP operates a computerized, on-line referral service, INFOTERRA. It covers a wide range of scientific and technological topics and the referral service is free of charge but individual sources may charge a fee for substantive information they provide. Presently, however, plans for expansion beyond referral, towards provision of substantive information, are under consideration. The referral service covers institutions in 120 countries. In all, the data base lists about 10,000 institutions and the national focal points and INFOTERRA (Nairobi) respond to about 500 queries per month; out of these, 61% were from developing countries and 29% from developed countries.

UNEP also operates IRPTC. The data base covers chemicals, their effects on health and environment, their safe handling and use, and regulatory control. The network includes correspondents in 100 countries. IRPTC also provides a Query-Response Service under which it supplies information on chemicals upon request. In 1983, 70 queries were received, 45% of which came from developing countries and 35% from developed countries.

UNEP, in co-operation with ESCAP, ECLAC, ECA, UNDRO, FAO, UNESCO, WHO, WMO, and IAEA, has established GEMS to collect data on environmental variables to provide a quantitative picture of the state of the environment and of natural and man-made global and regional changes.

UNCHS (Habitat) (United Nations Centre for Human Settlements)

Habitat plans to establish micro-computer-based bibliographic data base on human settlements by the end of 1984. The project is being implemented with the co-operation of UNESCO/PGI. The objectives of the project are to: facilitate transfer of human settlements-related technologies and experiences; provide tools for decision-makers in human settlements; strengthen regional consciousness of common problems; and insure maintenance and use of human settlements literature assets.

UNDP (United Nations Development Programme)

INRES/TCDC was established following the Buenos Aires Conference to collect and disseminate information on the

capacities of a developing country that are available for technical co-operation programmes, projects, and activities with other developing countries, through bilateral or multilateral arrangements. The activities covered by the system include training and education; research and technological development facilities; expert services; and consultancy services. In addition, since the Buenos Aires Conference, UNDP has been working on a proposal for a global development information network specifically designed for decision-makers at all levels in developing countries.

The DEVNET, when established, will facilitate information exchange between Member States through satellite communication. Services will be provided through subscription, it is designed to be financially self-supporting. Its data base will cover the entire spectrum of science and technology, economic and social development. The feasibility study is completed.

In addition to these two systems, UNDP has developed a data base covering all the projects it has funded, partially or wholly, since 1972. The PIM has been established primarily for internal budgetary and expenditure control purposes.

UNFSSTD (United Nations Financing System for Science and Technology for Development)

TIPS, a current awareness system, is proposed to be set up under the auspices of the UNFSSTD for determining the feasibility and viability of establishing a current information flow for strengthening the endogenous capabilities of developing countries in the field of science and technology and stimulate technical and economic co-operation among the countries by minimizing duplication of efforts. Once reliability is established through the TIPS project a wider coverage of scope and countries proposed in the project report on DEVNET is expected to be taken up.

The pilot project has the following objectives:

(a) To design a user-oriented exchange information system for selected science and technology subjects in a few developing countries including the organizational arrangement, selection and testing of hardware and software, developing management practices, etc.

(b) To train specialists of participating countries in all aspects of the project.

(c) To carry out user demonstrations through the national focal points in participating countries and an international co-ordinating setup.

(d) To test viability of providing user with access to selected information systems.

(e) To ascertain the willingness of participating governments as well as to prepare them for a successful operation of the network.

UNCTAD (United Nations Conference on Trade and Development)

UNCTAD has so far not established any specific data base or information system in this area, but has collected a substantive amount of material, data and information needed to adequately respond to the continuous requests and requirements of developing countries for assistance and co-operation in the field of technology. Much of the material relates to on-going activities of the Advisory Service on Transfer of Technology, established by UNCTAD Conference resolution 87(IV) in 1976, with the aim of providing technical and operational assistance to developing countries on issues related to the transfer, application and development of technology.

Most requests for information on possible alternative sources of technology stem from government bodies and public institutions engaged in policy-making and planning or responsible for the control, monitoring and promotion of technology transfer and the technical, economic and legal evaluation of projects. Among the most frequent requests are those relating to availability and alternative sources of technologies in certain critical sectors such as pharmaceuticals, food processing, capital goods and machinery, and energy.

UNU (United Nations University)

ASSET is a bibliographic data base that covers solar, wind and bioconversion energy. It is also an information network among 1,100 scientists and engineers in 115 developing countries. ASSET also prints a journal by the same name and distributes it to all its subscribers. There is no subscription fee for users in developing countries.

Specialized Agencies

FAO (Food and Agricultural Organization of the United Nations)

The two major information systems of FAO are AGRIS and CARIS. AGRIS has been operational since 1975 and was established to carry out the collection, storage and retrieval of information related to currently produced documents, reports and publications in the field of agricultural sciences and technology; and to develop a worldwide network of centres in charge of collecting, processing and dissemination of information on current agricultural literature under the co-ordination of FAO. AGRIS is a co-operative system and, as such, depends for its success on providing each participant with benefits that he perceives as justifying the efforts and resources that participation entails.

It is a bibliographic (indexing/abstracting) system with the following subject scope: agriculture; plant production and protection; forestry; fisheries and aquaculture; food and human nutrition; energy resources; agricultural engineering; agricultural economics; rural development; pollution; home economics; agricultural administration; agricultural research; education and extension; and natural resources. As of the end of May 1984, AGRIS data base had over one million entries.

The main users of the data base are government agencies, research institutes, universities, and industries. Its geographical coverage is worldwide, involving 131 national institutions and 14 multinational and international centres.

AGRIS publishes a monthly bibliography, Agrindex, for distribution to participants; it also provides on request cumulative indices on microfiche. The same information may also be obtained on magnetic tape. It also does retrospective search on request. AGRIS data base may also be searched online by authorized users through the following telecommunication networks: TYMNET, ESANET and EURONET.

AGRIS provides training courses for its users. These training workshops are usually undertaken at the national and regional levels and covers the use of AGRIS products, bibliographic description and subject control, including indexing. AGRIS also recognizes that for its products to be more use-

ful, there is a need to undertake promotion exercises at the national level, to this end FAO is producing a videotape with copies in English, French and Spanish for distribution to and use by AGRIS Centres.

As stated earlier, AGRIS is a bibliographic system and the problem of ensuring access to documents cited in it has not been easy. There are, however, pilot projects underway to find a solution. For example, the FAO coupon scheme is being studied. However, an overall solution must be sought in full co-operation with the publishing and library communities.

CARIS has been established to collect, store and make available information on agricultural research institutions, stations, research worker and research programmes and projects in developing countries and to develop a worldwide information system on agricultural research in developing countries through a network of national and regional centres. It has been operational since 1979.

It is a referral system with the following subject scope: plant production and protection; animal production and protection; forestry; fisheries and aquaculture; food and human nutrition; agricultural engineering; energy resources; agricultural economics; rural development; and education and extension in or related to developing countries.

The main users of CARIS are research institutes, government agencies, universities, non-governmental organizations and industries. FAO publishes in English, French and Spanish "Agricultural Research in Developing Countries". In addition, information is supplied on request either in print or on magnetic tape. CARIS geographical coverage is mostly developing countries involving 78 national institutions and 6 regional centres.

Each individual CARIS Centre is responsible for its own comprehensive data collection, correct data representation, processing of the data and effective utilization of the material provided by the co-ordinating Centre.

In addition to these two information systems, FAO also has a specialized data base, ASFIS, on aquatic sciences and fisheries. The data base broadly covers science, technology and management of the aquatic environment. The participating countries are mostly from the industrialized north, but out of over 1,000 subscribers to its Aquatic Sciences and Fisheries Abstracts, close to 200 of them are from developing countries.

The data base is bibliographic and covers serials, books and monographs, conference proceedings, reports, patents and research projects. ASFIS is a joint operation between FAO and the Intergovernmental Oceanographic Commission (IOC). The data base is loaded on five information systems which have on-line search services, these are: DIALOG, CANOLE, DOCOCEAN, DIMDI and ESRIN. The main users of ASFIS data base are marine scientists, limnologists, and off-shore technologists. The services of ASFIS are free for its participants while for other users they are by subscription.

FAO Forestry Department also maintains a bibliographic data base called FGR. All member and non-member countries of FAO participate in this system. Information is disseminated through an annual publication entitled "Forest Genetic Resources Information". Search on request is also done for participants free of charge. The users of the data base are: from developing countries' forest research institutes (45%), government forest services (19%), individuals (1%), from developed countries (5%), and from the UN system (30%).

In addition, FAO Forestry Department also run FORIS. So far, data on 76 countries have been collected and analyzed and incorporated into the data base. The process of collecting, analyzing and adding the data from the remaining countries is continuing. FAO has published a directory on forestry seed.

FAO and UNEP in 1983 initiated the Data Bank on Animal Genetic Resources. So far, only 55 developing countries are participating. FAO has also set up the Animal Health Data Bank with data collected from all its members. Information is distributed once a year or upon request. The data banks' main users are veterinary services. The service is aimed at facilitation of export/import of animals and food of animal origin.

ILO (International Labour Organization)

ILO's largest information system is the LABORDOC bibliographic data base, with over 100,000 references and a growth rate of 400 entries a month. The subject scope covers industrial relations, labour laws, employment, working conditions, vocational training, rural development and technological change. It reflects the major continuing areas of interest of the ILO, as well as new topics (e.g. micro-electronics) which have an emerging impact on the labour scene. The geographical coverage is global. The data base is available for on-line search through the vendor System Development Corporation (SCD), as well as the International Development Research Centre (IDRC) of Canada. In addition, it is available, on an experimental basis, to selected users through Centre National de la Recherche Scientifique of France. Other services provided are retrospective searches and selective dissemination of information (SDI), it also publishes the International Labour Documentation (there are 587 paid subscribers to this publication) and will provide magnetic tape and microfiche at cost.

LABORDOC was developed initially to improve access to the collections of the ILO Library and therefore to serve clients of the ILO Library (including, but not only, ILO officials). It has been gradually made more widely available to users outside the ILO through commercial data base suppliers and through non-profit institutions, particularly in developing countries. At present, about 34% of the users are from developed countries and 17% from developing countries.

In addition to LABORDOC, ILO also maintains LID, a highly selective data base documenting on-going events and major trends in labour and social affairs and providing access to source material used for news reporting in the Social and Labour Bulletin (a quarterly journal published by the ILO since 1974); it provides a broad international overview of factual information and current thinking which is generally only available to limited professional circles and seldomly distributed to the general public. LID's strength lies in the consistent analysis of information considered by traditional reference libraries and information services as belonging to the unpublished "grey" literature, which is considered by ILO as contributing to a much broader picture of current trends in the labour world than is otherwise possible.

The nature and broad coverage of LID in scientific and technological issues are: impact of new technologies (including factory and office automation and biotechnology) on work environment, which includes such issues as stress, occupational hazards, ergonomic standards for visual display

unit work stations, regulations on work with hazardous substances, research work and initiatives at national level. The data base also includes national legislation, collective agreements, policy statements by governments, employers' and workers' organizations, as well as research on topical issues; it also covers labour policy, income distribution, industrial relations, personnel management, employment policies, unemployment, social security, migrant workers, multinational corporations, women workers, equal opportunity, apartheid, vocational training, rural development, land reform, and co-operatives. The geographical coverage is global.

The principal categories of users from whom specific information requests are received are: national occupational safety and health centres, UNIDO and other institutions dealing with social impact of new technology; decision-makers in governments and employers' organizations, trade unions in ILO Member States, government agencies, public and private corporations, the media, universities, libraries, researchers in the labour field, students.

The services provided include microfiche subscription (US$23 per annum) and on-line services through commercial vendors.

In addition to the above two data bases, ILO has set up CIS with a bibliographic data base CISDOC. The subject scope covers occupational medicine and physiology, industrial toxicology and environmental hygiene, accident prevention, safety engineering, loss control, conditions of work, ergonomics, human engineering, management techniques, training and education, occupational psychology and sociology, and labour administration. The data base has 21,000 entries and 2,500 new records are added per year. The following services are provided to subscribers at a fee: abstract journal, magnetic tape, microfiche, custom bibliographies and on-line access through CISDOC. In addition, there are forty-seven CIS national centres.

Also, a large amount of information on technological alternatives suitable for the socio-economic conditions of developing countries is disseminated by the ILO Technology and Employment Branch. This information covers various sectors, including rural road construction, small-scale manufacturing, forestry, agricultural tools and implements, renewable energy, and so on. It is disseminated in various forms: publications (e.g., technical memoranda series on specific products and processes, published jointly with UNIDO, FAO and UNEP), seminars, workshops, and so on. The ILO has also promoted the exchange of technological information among developing countries through the organization of study tours (in Africa) and the publication of a detailed directory of African technology institutions.

The ILO is currently planning to establish a formal system for the dissemination of technological information. The exact coverage and characteristics of this system will be defined in a feasibility study to be completed in 1985. The study will take into consideration demand for and supply of technological information.

UNESCO (United Nations Educational, Scientific and Cultural Organization)

The UNISIST/PGI is an information programme of a general nature designed to provide a conceptual framework for the establishment of national, regional and international scientific and technological information systems. It is aimed at promoting and co-ordinating international action to facilitate the transfer of information to promote economic and social development. The two basic priorities of the programme have been: (i) the creation and strengthening of national information capabilities of developing countries; and (ii) improvement of norms, methods and tools of information systems interconnexion. For example, UNESCO is presently developing the Regional Informatics in South and Central Asia (RINSCA), a system intended to eventually provide satellite linkups of information systems in seven countries in Asia. UNISIST has national committees in over 65 countries.

Among the several scientific and technical information systems and data bases is SPINES. It is a computerized bibliographic data base on science and technology policies. The subject scope is science and technology policy, management of scientific and technological activities, science philosophy, sociology of science and technology, science and technology resources, economics of science and technology, technology transfer, science and technology forecasting, project evaluation and psychology of scientific researchers. It was established to facilitate information exchange between Member States, hence its use is restricted to them and the organizations of the United Nations system.

In addition to these, there are other UNESCO information systems and services of which the following examples may be cited: MEDI and IBEDOC.

WHO (World Health Organization)

WHO is a highly decentralized organization and compromises a headquarters in Geneva, six regional offices, WHO Programme Co-ordinators Offices at the country level and field projects staff.

Information systems and services exist at all levels of the Organization and range from those that are highly computerized to those that are manually supported. At WHO Headquarters the Information Systems Support (ISS) is responsible for providing methodological and technological support for the development and operation of information systems at all WHO echelons and to collaborate with Member States in their development and application of informatics in health, including the provision, upon request, of methodological and technological support.

ISS is organized into teams that are functionally oriented to provide informatics support for two main areas:

a) the work of the WHO technical programmes; and

b) the management of the Organization's resources.

In the former category, there is a large number of information systems that have been developed in different areas of WHO's work. Examples of these are:

(i) The Management Information System for Tropical Disease Research (MISTR).

The Special Programme for Research and Training in Tropical Diseases (TDR) promotes and co-ordinates the participation of the world's scientific community in the planning and management of goal-oriented research, and in training and institution strengthening activities. The rapid expansion and the diversity of programme activities require systematic processing and analysis of operational data for day-to-day management of the programme as well as for evaluation of activities and progress. To fulfill these requirements an integrated approach in data/information management, MISTR was designed and established. The MISTR System is part of the WHO Headquarters data

base, which interfaces with the WHO "Master Mailing List", and is compatible with the WHO Administration and Finance Information System (AFI).

(ii) The Information Systems of the Special Programme on Research and Training in Human Reproduction (HRP).

This Special Programme is the main instrument within WHO for promoting and co-ordinating international research and development relating to family planning. By far the largest volume of HRP's information systems work is for the statistical data generated by the research projects: the clinical trials, epidemiological studies and operational and psychosocial projects. To support the processing of the scientific information, a computerized system was developed to store and update data derived from clinical trials carried out by clinical research centres and task forces in all parts of the world. To assess the results of these trials, it is provided for the retrieval, selection, analysis and presentation of these data in a variety of lists and tables as required by scientists. The Internal Management System developed for HRP provides HRP management with selective and timely information for: (a) financial and budgetary control of projects, task forces and other programme components; and (b) statistics: to produce various statistical reports, e.g. programme support to regions, countries, institutions and scientists.

There are a number of other computer-supported information systems in WHO of which the following are examples: (a) Oral Health Programme—Statistical data processing for surveys; (b) Mental Health Programme—Research management; and (c) Malaria Action Programme—Statistical data processing.

However, the rapid advances in micro-computer technology has led to a significant trend toward the utilization of this technology for the development of new information systems and the transfer of parts of the mainframe applications to micro-computers. Examples of these are: (a) Expanded Programme of Immunization—Management of immunization activities; (b) Maternal and Child Health Programme—Statistical data processing; (c) Communicable Disease Programme—Vaccine production management; and (d) Diarrhoeal Diseases Control Programme—Research management.

In the second category of ISS activities are two major systems which are meant for internal budgeting and programme control purposes. These are: The Administration and Finance Information (AFI) System, an integrated computer-based information system developed in support of the following WHO main user functions: budget preparation, budget control, expenditure accounting, general ledger, payment of claims, treasury, staff administration, payroll, pension fund and staff health insurance. The personnel system is being re-designed and integrated into the AFI system; and (b) The Master Mailing List system which has been designed to cater for the management of addresses and the distribution of WHO documents and publications and for the rationalization into one system of many separate mailing lists. Other technical systems, e.g. Special Programme for Research and Training in Tropical Diseases (TDR), Office of Research Promotion and Development (RPD), Diarrahoeal Diseases Control (CDD) are linked to the Master List system as part of their computer system requirements, i.e. use of addresses for Donor Agencies, meetings, WHO collaborating centres, etc.

Advantage is being taken of micro-computer technology for the development of other types of information systems; for example: (a) Management of Fellowships; (b) Inventory Control of Office Machines and Stationery; and (c) Office Space and Accommodation.

A study has been made of the linking together of all these information systems in WHO Headquarters by means of a Local Area Network (LAN). Installation of a LAN in WHO Headquarters is projected for 1986.

WIPO (World Intellectual Property Organization)

WIPO operates a programme of Free-of-Charge Patent Information and Documentation Services, which is comparatively a small part in the Global Network of Patent Information, for which WIPO acts as the global central focal point. Under this programme WIPO provides detailed information on technological solutions as described in patent documents to users free-of-charge. On the average, WIPO responds to about 300 queries a year. The subject scope covers all fields of technology.

WIPO, as the global central focal point of the patent information network, fulfills, in co-operation with the various regional and national industrial property offices, the following main functions:

Assistance to developing countries in establishing regional or national industrial property offices and patent information centres as future focal points;

Assistance to developing countries in the training of patent information specialists;

Periodical revision and updating of the common documentary language of the network, the International Patent Classification, and publication of this classification in English and French;

Promoting the use of the network and international co-operation in its further development;

Elaboration and maintenance of other documentary standards used by the network;

Assisting in the design of the services of the centre for bibliographic information on patent documents, INPADOC (Vienna) and in organizing its co-operation with the national and regional industrial property offices;

Assistance to individual users of patent information from developing countries by answering of specific and urgent information needs.

Furthermore, the standard-setting activities of WIPO in the field of patent legislation have a substantial impact on the information value of published patent documents in general and, in particular, on the completeness and reliability of the information disclosed therein. These standard-setting activities are supplemented by a Development Co-operation Program to assist developing countries in implementing appropriate legislation and administrative practice.

In addition, each national or regional industrial property office fulfills, *inter alia* the following functions:

Publication of patent documents concerning inventions for which protection has been granted or applied for in the respective country or region, and/or publication of secondary information means thereon, throughout the fields of technology;

Maintenance of a *complete* reference library of these documents;

Exchange of comprehensive collections of patent documents of other countries, and of secondary information sources thereon;

Maintenance of comprehensive collections of patent documents of other countries, and of secondary information sources thereon;

Translating the International Patent Classification in national language(s);

Implementation at the national level of international documentary standards in the field of patent documentation;

Furnishing of information services to users on the basis of the comprehensive documentary search files maintained, furnishing of selected patent documents and of secondary information thereon to the various *branch-oriented* information systems and information institutions.

WMO (World Meteorological Organization)

WMO/WWW makes available to all Member States meteorological and other environmental information through a worldwide system of centres linked together by a data transmission network. The WWW has three essential elements: Global Observing System (GOS), the Global Data Processing System (GDPS), and the Global Telecommunication System (GTS).

IAEA (International Atomic Energy Agency)

INIS is a data base which covers the substantive literature of nuclear science and its peaceful applications. The data base is compiled from inputs supplied by Member States and organizations, to whom the merged data are redistributed twice monthly. It is a bibliographic data base. It is also a decentralized network in which the responsibility for serving end users lies basically with the 87 national liaison offices of INIS members and not with IAEA, although at the request of the national liaison offices IAEA will sell microfiche copies of technical reports, as well as subscriptions, to INIS Atomindex. It also provides some on-line retrieval service on an experimental basis at cost.

It is a co-operative system and, as such, depends for its success on each participant providing information on his activities to the central data base in an agreed form and in so doing receiving in return what has been collectively compiled.

Inter-Agency

ACCIS (Advisory Committee for the Co-ordination of Information Systems)

ACCIS is an interagency body with membership comprising all the organizations of the United Nations system. It has two main aims, namely: to facilitate access by Member States to United Nations systems information; and to promote the improvement of the information infrastructure within the United Nations system. It was set up in 1983 in response to ECOSOC resolution 1982/71.

ACCIS' activities help to ensure the more efficient operation of planned or existing United Nations information systems and services by enhancing their capacity to collect, store, retrieve and disseminate information. It deals primarily with information systems containing substantive information available within organizations of the United Nations system and of potential use to Member States. Such information systems may provide substantive data — such as a statistical information system — or systems which only refers sources of information. Among the latter are systems reporting on current research, technical co-operation projects, training materials, bibliographic materials and so on.

Much information is available in the United Nations system (if one knows where to look); more is hidden away (and should be uncovered). A big part of the problem is simply making existing information more readily accessible. ACCIS tackles this in two ways: by preparing material which gives an overview of United Nations information resources; and by promoting its diffusion through each organization to Member States and users at the national level.

ACCIS has compiled a directory of information systems operated by United Nations organizations. This new directory of information systems and services is just one of a number of guides and directories prepared and disseminated by ACCIS. Other new tools are being studied: a database describing serials produced by United Nations organizations; a database on economic and social development documents published by United Nations organizations; a register of technical co-operation projects. This register will provide ready access to information on technical co-operation projects financed by and/or executed by organizations of the United Nations system.

Most United Nations organizations have used computers for many years. Advances in telecommunications technology now make it possible for computers in different locations to communicate with each other studying ways of facilitating such connections. ACCIS also provides an advisory service to United Nations organizations regarding proposals for new information systems, or the modification of existing ones. The aim is to facilitate access to information recorded by systems in the same or related field and, where possible, to avoid unnecessary duplication.

More and more Member States are setting up information systems and wish to acquire selective information from the United Nations system. They may also wish to install small computers to be able to process this information according to their own needs. ACCIS offers assistance in both these areas. ACCIS publishes a bi-monthly *ACCIS Newsletter* which reports on ACCIS activities, reviews recent developments in information technology, looks at new and improved systems within the United Nations system, gives details of seminars/conferences on information-related topics; and reviews pertinent new publications.

RAHNIS: Co-operation between UNESCO and ISRDS-CNR within the Field of Scientific and Technological Information System for Development

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Motivation and Goals of the Information System

Scientific research and technological development are built on previously accumulated knowledge, and derive their direction and vitality from the exchange of current scientific ideas and methods. Timely access to all relevant information thus becomes a prerequisite for successful activities in science and technology. This fact is today universally acknowledged and has led to the establishment of a great many complex data bases and information systems.

Intended to satisfy the information needs of specific groups of researchers, most of the existing data bases focus exclusively on one or another of the traditional disciplines or subdisciplines of the natural sciences or on major areas of technology. Scientists pursuing problem-oriented and therefore multidisciplinary research usually cannot rely on one single source for the information they need, and a time-consuming search of existing disciplinary data bases must often be undertaken. Moreover, although access to the various data bases is in theory easy, the current proliferation of such systems, and sometimes the cost of using them, tend to discourage their use by the scientist interested in multidisciplinary research. In fact, information in existing information systems in rarely available, especially to scientists and researchers in developing countries.

Information Referral Service on "Research and Human Needs"

Since its inception in 1975, UNESCO's programme on Research and Human Needs had matured and grown considerably in scope. The initially small core of scientists who contributed to this effort has expanded impressively, to the point where programme-related activities are carried out world-wide. Four regional groups exist now in Africa, Asia, Latin America and Europe each concentrating on research in problems which, regionally, demand the most urgent attention. Many requests for information are received from scientists in member states who are interested in this fresh approach to problem-oriented scientific research and who intend to join forces with researchers already engaged in similar efforts. Up to now, information on research linked to satisfaction of human needs was collected and disseminated by UNESCO, for instance through the compilation and distribution of the first and second Directory and Bibliography on the theme "Research and Human Needs" (SC-81/WS/111). While this mechanism was entirely satisfactory during the early stages of the programme, it has been apparent for some time that the system would prove too limited as more and more scientists join programme related activities.

Consequently, the participants at the Interregional Meeting at Trieste, 10 - 13 December 1979 recommended the establishment of an Information Referral Service on problem-oriented research linked to the satisfaction of human needs. Emphasis is to be placed on a "bottom-up" approach favouring practical and straight forward means of providing access to relevant data.

The ISRDS-CNR was charged to prepare a feasibility study for the establishment of RAHNIS (Research and Human Needs Information System).

Structure and Operation of the Information System

On the basis of the ISRDS-CNR proposals, the information system will consist of a network of co-operating regional and subregional information centres, with one of them assuming the co-ordinating role. Each centre will be responsible for the collection of data on regional activities as well as for the dissemination of data collected by the network as a whole.

The Centres will respond to individual inquiries on research related to satisfaction of the human needs, providing data that will enable the user to establish direct contact with the primary sources of information, i.e. the name and address of a particular institute or scientist, data on existing publications, and the like. This referral mechanism will encourage regional and interregional co-operation between scientists engaged in similar types of research and thus contribute in an important way to a reinforcement and strengthening of the programme on Research and Human Needs.

Operations

The operation of the network can be understood in terms of three elements: collection of information, information exchange between centres, and information processing and dissemination by a given centre.

Collection of Information

Each centre assumes the responsibility of collecting information on regional or subregional activities related to Research and Human Needs.

Regarding the initial information content of the information system, the working group at Trieste noted:

As a start, core data should be collected on Institutes engaged in projects on Research and Human Needs, their researchers, and their specific research projects. Both bibliographical and factual information should be included. It was recommended to concentrate on research related to the social and natural sciences, although significant technological programmes, especially when closely related to scientific research, should be considered as well.

Initially, information will be solicited from institutes and researchers directly, using carefully devised questionnaires. The information will be in the language most often used by the scientists of the region in the course of their work and in English, the common language of the network.

Centres that have the capability to do so will record the collected information on computer tape using a standard agreed-upon format (International Standard). Participating centres that do not have access to computer facilities will file the information on paper. The information so collected will be sent at fixed time intervals to the co-ordinating centre which will produce a marged master file on computer tape, microfilm or paper for use at any of the centres.

Information exchange between centres

Information will be exchanged between the centres via the co-ordinating centre. At fixed time intervals, copies of newly received questionnaires or, preferably, the same information recorded on computer tape, will be sent to the co-ordinating centre, which will merge and eventually update the data from the various centres and produce a master file on magnetic tape. Copies of this tape will then be sent to each of the centres with computer facilities. Centres that do not have access to a computer will receive a print-out of the master file on paper or on microfilm.

Dissemination of Information

Once the information from the centres of the network has been merged and updated and the master information sent to each of the individual centres, the centres will function autonomously. Upon request from its region, each centre will supply the information the best way it can, using the microfilm reader or the paper printout provided by the co-ordinating centre to locate the requested information manually or performing a computer search of the magnetic tape.

Centres that have access to a computer will in many cases also have access to computer software capable of analyzing data bases. In this case, all that is needed is additional, relatively uncomplicated software to read the master tape and convert the format of the data to one which is compatible with the existing data base software.

In the first few years of operation, the collected information will be disseminated in the form of a printed directory only, postponing to a later data individual replies to users that involve on-line data base searches.

Organization Structure

The RAHNIS system will function as a network of regional and subregional information centres, with one of them assuming the Co-ordinating role.

Co-ordinating Centre

During the first few years of operation, it is necessary that the co-ordinating centre specialize on the building of the computer data base, i.e. the storing of the collected information in computer-readable form and the development of methodological tools for the updating and retrieval of data. The co-ordinating centre will also be responsible for the preparation and printing of an annual directory containing the collected information. This directory will initially be the only output of the RAHNIS system and thus must be prepared with great care.

Regional Centres

The regional centres will initially concentrate on data collection in their regions, identifying sources of information, screening the collected information, and seeking clarifications and/or additional information where questionnaires are misleading or incomplete. The information so collected will then be forwarded to the co-ordinating Centre.

Advisory Board

It is proposed that an advisory board be established consisting of scientific researchers representing users of the system in the various regions. The advisory board will periodically asseas the effectiveness of the RAHNIS system from the users' point of view and advise UNESCO on matters relating to structure, operation and content of the information system.

Liaison Committee

A liaison committee consisting of representatives of participating regional and subregional information centres will assure the overall co-ordination of the operational and technical aspects of the network. The liaison committee will implement the recommendations of the advisory board and advise this board on all technical and operational matters. The chairman of the liaison committee will be a member of the advisory board.

RAHNIS Questionnaire

A draft version of the RAHNIS questionnaire was prepared by Mr. Mentalecheta, of the the Conseil Nationale pour l'Informatique of Algeria. He discussed this draft with scientists and information specialists during his visit to information centres in Algeria, France, India, Italy, Poland, and Venezuela. The draft version and the various comments and suggestions on it formed the basis for the establishment of a first RAHNIS questionnaire, with versions in both English and French, prepared by the ISRDS-CNR.

It was considered important to test the effectiveness and suitability of the questionnaire by mailing a certain number of copies to institutions in the various regions and subsequently to evaluate the responses. In these mailings a brief explanatory note on the RAHNIS system and Guidelines for completing the questionnaire accompanied the questionnaire.

TCDC-Type Mechanisms for Sharing Technical Information: the Technonet Experience

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Introduction

Sharing of technical information for small and medium industries (SMIs) among developing countries, through networking arrangements, can be an effective mechanism in the delivery of vital information to the target users. This, in brief, summarizes the philosophy behind the mission and objectives of Technonet Asia. This belief is founded on Technonet's eleven years of experience promoting and facilitating the exchange and absorption of appropriate technologies for SMIs.

At the outset, it is worth emphasizing what may perhaps be already a cliche in many workshops and conferences, but still a dream yet to be translated into reality for many developing countries: It is the inescapable fact that developing countries have much to share with each other in terms of technical information, processes, and expertise. What is needed is the stimulus to spur this co-operation and interchange and even bring to the surface this capability — a role which can be properly undertaken by international assistance agencies and which Technonet Asia has over these years ably demonstrated.

Technonet Asia: Asian Network for Technical Information and Extension

Technonet Asia is a co-operative grouping ("network") of, at present, 14 participating organizations in 11 Asian-Pacific countries (see Annex I) which aims at improving the quality and efficiency of production in those countries' SMIs. Started in 1973 as a project of the International Development Research Centre (IDRC) of Canada, Technonet became an independent, non-political, non-profit, and non-stock legal entity registered under the laws of Singapore in 1980.

Technonet Centre, located in Singapore, acts as the focal point for the network. It is headed by an Executive Director who, together with heads of the participating organizations, comprise a Council which meets at least once a year for policy deliberation. In addition, an Executive Committee of five members is selected from among the Council members to advise the Executive Director and the Council on policy matters.

Technonet programmes revolve on four interrelated areas, viz: (a) technical information service; (b) industrial extension and consultancy service; (c) transfer and sharing of technology; and (d) enterprise and entrepreneurship development.

Technonet's programme matrix is shown in Figure I.

Information Infrastructure: Technonet's Response to SMIs' Needs

SMI entrepreneurs are faced with two extremes in their search for technological information — either too little information is available to them, since many SMIs do not have access to information centres; or, a wide range of information is available and the problem becomes one of choosing the appropriate technology or the adaptation of the technology to suit the specific situation.

Information centres are often asked "difficult" questions —difficult in the sense that the information is not available locally, but can be readily obtainable in other countries if the right linkage is found. Some examples of such inquiries are:

- —How do we breed crocodiles in Agusan? (from the Philippines)
- —What is the market potential of handicrafts in Singapore? (from Malaysia)
- —What is the technology for gold plating on orchid flower? (from Thailand)

With this backdrop of the information needs of SMIs and their peculiarities, Technonet has drawn up the mechanism calling for TCDC-type activity.

The organizations participating in the Technonet Asia network have two common aspects which, despite their diversity in size, resources, and individual thrusts, have been the motivating force in binding them together in a voluntary and mutually reinforcing manner: (a) they are all involved in rendering assistance to SMIs in their respective countries, and (b) they are all specialized in the technical aspects of industrialization.

To make the network operational, on a mutually acceptable basis, the participating organizations agree to: (a) share with one another industrial technical information on products and processes in their country that is readily obtainable; (b) receive personnel from other participating organizations for observation, training and sharing of experiences, as appropriate; (c) make available their technical personnel for short-term assignments to other participating organizations; and (d) arrange visits of SMI entrepreneurs, government policy-makers and technical staff from participating organizations' countries to local industries, organizations, and institutions.

Examples include Technonet's intervention in facilitating the transfer of technology for gold plating of orchids from Singapore to Thailand, production technology for making coconut candy from the Philippines to Sri Lanka, and metal accessories technology from Malaysia to Bangladesh, among hundreds of other similar cases.

Individually, within their respective home environments, the participating organizations establish effective co-ordination and liaison with local institutions concerned with the development of SMIs, as well as with local sources of technical information and expertise to facilitate such development and to assist other participating organizations in their development efforts.

Technonet Asia has contributed considerably in the development and upgrading of technical information services of several participating organizations using various kinds of "software" (e.g., study tours for industrial information officers and specialists, conduct of information analyses, processing and repackaging courses) and hardware facilities (e.g., computer, microfiche reader, printer, slide projector). It has funded several information-related projects for its participating organizations in such fields as technical inquiry service, "current awareness" service, selective dissemination of information, and the publication of directories of sources of information, appropriate technology digests, newsletters, and the like. The idea is to assist these participating organizations in undertaking pioneering and innovative information-related projects, with the ultimate objective of ensuring continuity of the information service through financial self-reliance on the part of participating organizations.

At present, three participating organizations provide the main backup for Technonet information services: the Singapore Institute of Standards and Industrial Research (SISIR), the Hong Kong Productivity Centre (HKPC), and the Korea Institute for Economics and Technology (KIET). All three provide a Current Awareness Service and on-line information retrieval service. All the participating organizations are prepared to handle technical inquiries within their fields of expertise. In addition, Technonet has established links with some 200 sources of specialized technical information world-wide.

Several Technonet participating organizations repackage information acquired abroad to suit SMIs' needs in their respective countries. A few of them provide translation services (Hong Kong, Korea, Thailand). Several journals and bulletins, as well as pamphlets and manuals, are regularly published (metals, plastics, chemicals, furniture, and the like). For its part, Technonet Centre publishes a quarterly newsletter and a Technology Digest which brings to the readers technologies developed within the region and those from the West that are appropriate to the region.

While all the participating organizations have terms of reference that permit them to be active across the entire industrial sector, experience has shown that needs are greater in some types of industry than in others. To identify priority industries, the following list of industries arranged in order of their degree of need for technical information has been agreed upon:

1. Metal
2. Food processing
3. Wood-based industries
4. Plastics
5. Packaging
6. Electrical appliances and products
7. Agricultural waste utilization
8. Ceramics
9. Rubber products
10. Footwear
11. Leather
12. Building materials

These broad industry classifications have been further refined in order to arrive at more specific areas of activity. A matrix of expertise and sources of information has been drawn up identifying the needs and strengths of participating countries. Centres of excellence in specific fields have been encouraged, to minimize the wasteful duplication of efforts. For example, the establishment of a Plastics Technology Information Unit (PTIU) within HKPC in Hong Kong, and the upgrading of the Foundry Workshop at IDB in Sri Lanka, have been supported on the understanding that their expertise and facilities will be available to all the other participating organizations.

The Human Factor in Information Sharing Technonet's Uniqueness

What is perhaps unique in Technonet is its heavy reliance on the "human element" in the delivery of technical information. Technonet Asia believes that an effective transfer of technology program is very labour-intensive. It can be successfully implemented only by people—a cadre of well-trained and creative technical information specialists and industrial extension workers who are the vital inks between sources of technology and the SMIs. At present, this cadre consists of a rapidly expanding group of some 5,000 industrial extension practitioners, who are constantly involved in factory visits to solve problems right there on the shop floors. They also act as "processors" of technical information—interpret it, and adapt it to the needs of the SMIs. Over 50,000 cases are being handled each year within the network.

To effect such a programme is not an easy task and Technonet contributes its share in the building up of the pool of trained industrial extension manpower by conducting Industrial Extension Training Courses (INDEXTRAC), both as regional and countrylevel activities. To make extension service effective, Technonet sees to it that participating organizations are backstopped by a technical information network — on both a national and international level.

Conclusion

There is nothing new to the Technonet concept. It has been discussed before. Proposals have been made for technology data banks, new systems for the international referral of technical inquiries, reforms in the international patent system, and inevitably, new institutes where well-endowed researchers can develop theories about how it can all be made to happen. What is really new—and what can be of enormous benefit to other developing regions in the world—is that such a network can be workable. Developing countries have much to share with each other; and the developed countries, through their technical assistance programmes, can strengthen this capability.

Yet, while no one denies that the industrialized countries and the international agencies could be more effective in stimulating the diffusion of technology, at the same time there is a growing realization that the greater part of man's technological know-how is already freely available and the biggest problem is that the developing countries are ill-equipped to find, evaluate, and apply it. By strengthening the capabilities

of its participating organizations, Technonet has succeeded in facilitating the transfer of technology and its assimilation to SMIs. After all, Technonet is, in its fullest sense, a true believer in the Vienna Programme of Action, despite its existence six years before this promulgation, when it said,

> "International organizations should act as a tool for systematic exchange of information on experiences of different countries in all fields pertaining to the application of science and technology for development".

ANNEX I:

List of Participating Organizations in Technonet Asia

Bangladesh	Bangladesh Small and Cottage Industries Corporation (BSCIC)
Fiji	Fiji National Training Council (FNIC)
Hong Kong	The Hong Kong Productivity Centre (HKPC)
Indonesia	BIPIK/Departemen Perindustrian (Ministry of Industry) (BIPIK/DP)
Korea	Korea Institute for Industrial Economics and Technology (KIET)
	Small and Medium Industry Promotion Corporation (SMIPC)
Malaysia	Standards and Industrial Research Institute of Malaysia (SIRIM)
	Majlis Amanah Rakyat—Council of Trust for Indigenous People (MARA)
Nepal	Industrial Services Centre (ISC)
Philippines	Institute for Small-Scale Industries University of the Philippines (UP ISSI)
	Economic Development Foundation (EDF)
Singapore	Singapore Institute of Standards and Industrial Research (SISIR)
Sri Lanka	Industrial Development Board (IDB)
Thailand	Department of Industrial Promotion, Ministry of Industry (DIP)

FIGURE 1. TECHNONET ASIA

PROGRAMME MATRIX

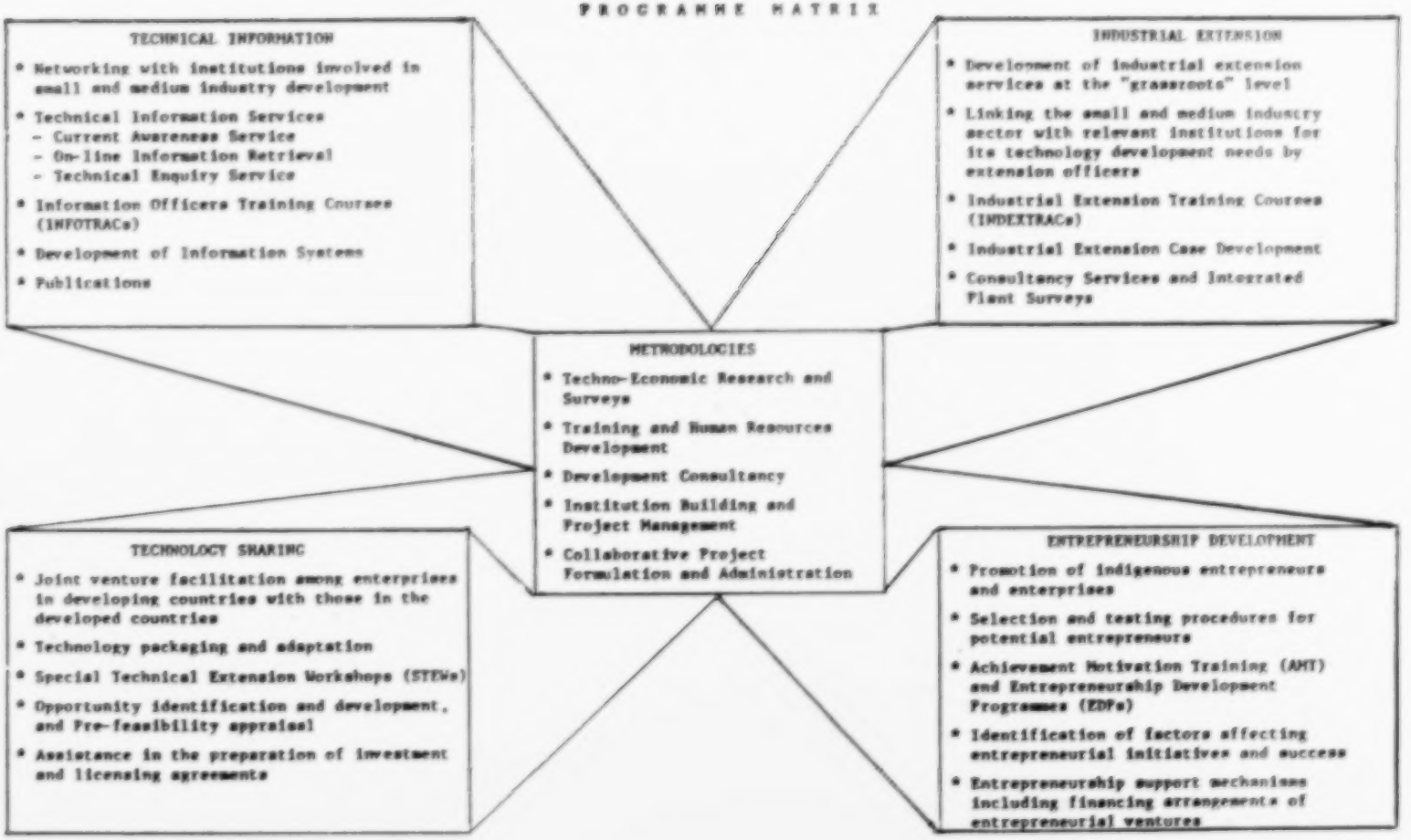
TECHNICAL INFORMATION
* Networking with institutions involved in small and medium industry development
* Technical Information Services
- Current Awareness Service
- On-line Information Retrieval
- Technical Enquiry Service
* Information Officers Training Courses (INFOTRACs)
* Development of Information Systems
* Publications
INDUSTRIAL EXTENSION
* Development of industrial extension services at the "grassroots" level
* Linking the small and medium industry sector with relevant institutions for its technology development needs by extension officers
* Industrial Extension Training Courses (INDEXTRACs)
* Industrial Extension Case Development
* Consultancy Services and Integrated Plant Surveys
METHODOLOGIES
* Techno-Economic Research and Surveys
* Training and Human Resources Development
* Development Consultancy
* Institution Building and Project Management
* Collaborative Project Formulation and Administration
TECHNOLOGY SHARING
* Joint venture facilitation among enterprises in developing countries with those in the developed countries
* Technology packaging and adaptation
* Special Technical Extension Workshops (STEWs)
* Opportunity identification and development, and Pre-feasibility appraisal
* Assistance in the preparation of investment and licensing agreements
ENTREPRENEURSHIP DEVELOPMENT
* Promotion of indigenous entrepreneurs and enterprises
* Selection and testing procedures for potential entrepreneurs
* Achievement Motivation Training (AMT) and Entrepreneurship Development Programmes (EDPs)
* Identification of factors affecting entrepreneurial initiatives and success
* Entrepreneurship support mechanisms including financing arrangements of entrepreneurial ventures

Figure 1. Technonet Asia
PROGRAMME MATRIX

Economic Issues Facing North-South Information Enterprise: the NTIS Experience

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Introduction

NTIS completes fifteen years of service in 1985 as a self-supporting, autonomous agency of the United States Department of Commerce, but its predecessor organizations date back to 1945. In that year President Truman signed Executive Order 9568 establishing the Publications Board in order to make available the results of Government-sponsored research, mostly conducted during the Second World War.

In 1964 the Clearinghouse for Federal Scientific and Technical Information (CFSTI) was established to handle those functions. In 1970 that organization was renamed and reorganized as the National Technical Information Service (NTIS). NTIS is the central source for the public sale of United States Government sponsored research, development, engineering, and other technical reports, as well as foreign technical reports and other analyses prepared by local government agencies or their contractors or grantees. It is also the source for federally generated, machine-processable data files, and it manages the Federal Software Exchange Center for intra-government distribution. NTIS is one of the world's leading processors of specialty information.

The NTIS collection:

—exceeds 1.4 million titles,

—includes 350,000 foreign items,

—adds 75,000 new reports annually,

—ships approximately 24,000 information products daily, and

—offers permanent availability of documents, in support of the data base of bibliographic references.

NTIS is the recipient of report literature resulting from some $US40 billion in United States government sponsored research and development. As part of the Department of Commerce, NTIS is responsible for assuring the adequate acquisition, storage, retrieval, and dissemination of productive technical information resulting from government research. Its products and services and programs are intended to increase the efficiency and effectiveness of United States research and development, to support foreign policy goals by assisting the social and economic development of less developed countries, and to increase the availability of foreign technical information in the United States.

Another initiative at NTIS concerns United States Government inventions. It handles the promotion, licensing, and foreign patent filing for those inventions assigned to the Department of Commerce. As the largest single source of United States Government sponsored technical information, it covers a broad spectrum from the sophisticated manuals on raising rabbits and keeping bees which use hand-drawn caricatures.

How NTIS is Perceived Overseas

To some, government-sponsored research seems unattractive, because it appears not to be at the "cutting edge" of commercial, industrial development. Closer examination of the facts assuages these concerns. Most government research is carried out by private industry, under contract, so the quality of the work is assured. The fact that projects are publicly funded means that these subjects are even more likely to be relevant to LDCs than products intended for commercialization in the United States marketplace. One study (Beverly, 1977) estimated at least 5 per cent of the NTIS collection was relevant to less developed countries, or 70,000 reports.

Since 1971, NTIS has had varying numbers of staff assigned to working on the expanding access to NTIS in developing countries. It has been a high priority of each Director of the organization, and since 1976 there has been a special inter-agency agreement with the Agency for International Development to accommodate the special needs of the marketplace in the Third World. Some of the principal obstacles to overcome were pointed out in a National Academy of Sciences study on the problems of information access in less developed countries (National Academy of Science, 1970), as follows:

—lack of foreign exchange,

—lack of local focal points for reference or access,

—great distances (time delays),

—lack of training in management and utilization of technical information,

—adaptability and suitability of what is available,

—unwillingness of United States sources to share their information, and

—high costs.

The High Cost of Doing Business

NTIS employs approximately 450 people at its headquarters outside of Washington, D.C. Our operating budget for

1984 was approximately $US30 million. Although NTIS occasionally receives outside support for special programs, almost all our budget is derived from the sale of products and services. The NTIS budget operates out of a separate account from the nation's Treasury, so that we are made to feel closely accountable for covering our operating expenses.

NTIS is required by its Congressional charter to recover its operating expenses in this way, while keeping its charges to the public a minimum. This does not mean that every product recovers exactly its cost of production. Rather, the overall operating budget is covered through revenues earned. Certain activities, such as the patent licensing program, anticipate a return of significant earnings to the Treasury in the future.

Our premise at this meeting is that in large part because of the requirement that NTIS operate as a business in this publicly responsible activity, NTIS is a uniquely flexible and strong government agency. The principal linkages with the emerging international network of information services will be those which improve the productivity of the users and/or the information centers or services themselves.

On the one hand, NTIS is eager to participate in the international community and to make a contribution to increasing international linkages toward a global international network. Our efforts thus far have demonstrated several areas where the cost of such participation is a serious obstacle to us and to those poorer systems with whom we are trying to collaborate. We list them here, with a brief commentary, in search of suggestions as to how to manage these activities more efficiently.

Acquisition and Transmittal

Within the United States we have a full-time acquisition program handled by two specialists on our staff. More than 50 per cent of NTIS documents originate with the Departments of Energy and Defense, and NASA. The other 50 per cent comes from more than 350 sources around the world. There are many organizations which never bother to submit their reports to NTIS, out of the lethargy or ignorance of our existence. They need to be shown the benefits of co-operating and taught how to take advantage of the systems.

Input Processing and Cataloging

This strictly internal activity must meet certain minimum standards in order to be an acceptable commodity internationally. NTIS probably is too highly developed for some developing country circumstances at present. For example, the level of specificity in our indexing reflects the large number of reports being entered into the data base each year. As a result of this high level of specificity, a small subset of the collection may have as many headings as entries. A sector-specific international network might help devise a system for converting apparently incompatible thesauri, and broader cataloging systems.

We face an average input processing cost of around $US70 per document manually processed. This cost can be reduced if each of the national information systems performs some of the functions itself. It appears that the success of the SATIS network is worth examining in this regard.

Special Handling of Orders and Shipments

The distance to a foreign user can make a simple transaction especially difficult. (Within the country the difficulty is not so great because of the sophisticated and inexpensive means of communication available.) For this reason, we are satisfied with doing domestic business with our principal clients by direct mail. However, overseas we have judged it necessary to initiate a system of local sales representatives and reproduction centres.

The improvement of electronic media at the international level in the near future may change our approach, however, and the implication are similar to reach national agency like ours. Why should anyone make a capital investment in a microfiche library and reprographic centre if the text of the report can be transmitted electronically? Telefacsimile is only a poor hint of what is to come. The storage of technical reports in digital form promises to increase our capability to retrieve full text quickly and inexpensively, and to transmit it to anyone with equipment to receive it. We recognize that this is a serious caveat for some countries.

Meanwhile, the challenges of dealing with different customs systems and regulation, very unreliable mail services (including our own, sometimes), and the need for a local contact to help out the unknowledgeable end user, will argue for continued use of local representatives and distribution centres.

Monetary and Accounting Problems

As mentioned in most documents on this subject, the scarcity of hard currency and local restrictions on expenditure of such currency is a persistent problem. A deposit account system, such as we currently employ, can facilitate the accounting and payment functions; but at the (small) cost of cash availability. For large users this is not much of a consideration, since funds do not sit idle in the account. We have experienced serious problems of bank draughts being "lost along the way," either due to mistaken information in the transaction, or inept handling. Then, the time lag experienced in receipt of account statements results in the clients or even the dealers not learning of a problem until very late in the transaction.

It is necessary to devise and experiment with alternative methods of accounting and payment to help avoid the current problems of convertible currency and funds transfers.

Marketing and Promotion

NTIS has been a unique government agency for many years in recognizing the need to study the market and promote its products in the marketplace. In our annual training courses organized on behalf of foreign users, the marketing segment is now unquestionably the most popular. Still, we are dissatisfied with the level of international marketing activities, in our own programs and those of our colleagues.

For economies of scale, we tend to promote our products broadside, directing our messages not to an individual country but to a region and perhaps the whole world. Also, we tend to take our principal clients for granted while recruiting business from the general public.

Conclusions

At a time when the entire civilian bureaucracy of our country and those of most other countries as well is being drastically reduced, NTIS seems protected and untouched by these reductions because of its solvency and financial soundness. This is not said by way of boasting; it is set forth as a lesson to us all.

Insofar as this meeting and those that follow envision the creation of a global network of information services, we must sustain the principle of fiscal soundness and productivity, or the results will be short-lived. Two themes derive from these principles:

1. Allowing that this system will not pay for itself at the outset, user fees must be anticipated in order to deter uneconomic use of the system. As the members discover products and resources that they can share and that can meet a need in their regions or sectors, new and more efficient methods of paying for these services must be contrived. We would be pleased to participate in such experiments.

2. Our basic mission is to establish and clear the channels which will permit an optimum flow of information to those who will make use of it. Insofar as we are able to "add value" to this information, we will be strengthening our own marketplace and the industry overall. Each national member of the international network should take responsibility for devising ways of adding value to the information in which we are trafficking.

Finally, in the United States it is commonplace to hear the protest that one can no longer keep up with the deluge of information. And in our industry, it is difficult to keep up with the technologies for managing our information. So far, we have been focusing on the telegraphic-telephonic media and the print media. New discoveries are leading us into the maze of electronic media. We do not pretend that we have resolved the problems and conflicts which threaten to arise out of adopting these new forms of communication, but we cannot avoid these aspects of technological progress out of fear of the problems they might entail.

NTIS is presently experimenting with new technologies both for the internal management or our operations and for our relations with developing and developed countries alike. We look forward to sharing the results of these experiments with you, in support of the emerging international network.

SATIS: A Network of Institutions

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Introduction

A key feature of development processes in recent years has been the proven, cost-effective "ability to deliver" NGOs (non-governmental organizations). The execution of many development projects is now delegated by official national and international agencies to NGOs.

Among the new-generation NGOs are the estimated 4,000 groups engaged in science and technology application for development.

The prime activity of the NGOs in technology application is field action-research work, promoting, supporting, and sharing development efforts. In addition to their practical technical, organizational, and communications work, they also have brokerage, advocacy, and networking roles. They often act as links between the supply and demand of financial, technological, human, and organizational resources, liaising between groups separated by either a mere few kilometres, or several thousand. In this work, they adapt and enhance technologies based on existing stocks of knowledge, and they share with others their research work on upgraded and emerging appropriate technologies. A key role of these organizations is to provide an essential communications link between the basic, felt needs of developing communities, and the resources of the science and technology communities that may be mobilized for practical development goals. This delicate work requires that needs be fully and properly perceived and assessed. Further, because of their clear understanding of community needs, the NGOs can help to ensure that the scientific and technological responses to existing and anticipated needs are practical and viable within the actual resources of a community or nation.

In addition to concrete applications, the demonstrative effect of these NGOs helps the diffusion of applicable and replicable technologies. Thus they enhance the notion of technology use by policy maker, planners, and the scientific community, facilitating their decision on technology assessment, science policy, education, training, rural investment, and fiscal measures to promote local enterprises.

Co-operation between these groups and other institutions, government departments, and agencies is growing, as they move to share skills, resources, and concerns. Networks are emerging between groups working in the same areas of geography, ecology, and/or interest: for example, there are consortia of appropriate technology and small-business groups; trans continental networks of researchers on renewable energy, on energy-efficient cookstoves, on medicinal plants, and on water treatment; and information/advocacy networks.

One such network, specializing in information and communication on the manufacture, maintenance, and management of technologies and processes for popular development, is SATIS: Socially Appropriate Technology International Information Services.

The Work Which SATIS Facilitates

Satis is an international association, founded in 1982 by twenty-five organizations, after a preparatory period starting in the mid-1970s. Our founder members are principally non-governmental organizations, with roughly equal numbers coming from Asia, Africa, Latin America and the Caribbean, and North America and Europe. Their common objective is to promote economic and social improvement in rural and marginal urban areas by providing a series of technological project and consultancy services to local development agencies, peasant women, village, and enterprise groups.

Some examples of the wide-ranging activities of our members are:

—promotion of small-scale palm-oil extraction in Cameroon;

—establishment of producer/marketing co-operatives for herbal medicines in Guatemala;

—winged-bean processing plants in Java, Indonesia;

—upgrading of pottery products as construction materials and for food storage in India;

—training in improved construction techniques for sanitation systems in the Caribbean;

—publication of popular/peasant science magazines in the Andes region;

—promoting appropriate technology courses in European technical education;

—linking small-business skills in appropriate bakery development, between those in the Netherlands and those in Kenya;

—conducting environmental impact and damage limitation studies in Senegal and Indonesia;

—feasibility studies on small-scale bicycle manufacture and pedal-power applications in Central America; and

—recording verbal histories — including "rural technology tales" in Tanzania.

Our founder members, partners and the hundreds of other groups using the services of SATIS are aware that the success of their work relies heavily on access to reliable and practical information on technologies and on the associated organiza-

tional and financial processes. Because our members often work in innovative, multidisciplinary ways, there is a particular demand for evaluative information on the field experiences of similar organizations.

SATIS was founded by its members to enable them and their partners to create and maintain tools for the management and exchange of information essential to their work for development. Despite its modest size, its special form as a network of institutions provide some indications of the issues involved in genuinely global networks.

SATIS Programmes

The work of SATIS is divided into three programme areas, aimed at enhancing information within the broader activities of our members, partners and co-operating organizations.

The programme areas are (a) access to and exchange of information; (b) diffusion of information, resource development; (c) resource guides.

Underpinning the work in these programme areas is the SATIS information system, composed of several information management tools, for the registration, classification, retrieval, and exchange of information. The system includes a recording system, agreed-on international procedures for exchange, a detailed classification, and a growing thesaurus. It was created in the 1970s, in response to the specific needs of many small and organizationally strained technology and development NGOs, for which the then existing "traditional" information systems matched neither their new, interdisciplinary conceptual needs, nor their organizational resources.

Designed and developed by such groups, the system has now been adopted and adapted by more than 300 organizations, some of them large, international agencies, in more than 50 countries. In addition to the official versions of the system in Spanish, French, and English; we are aware of the existence of "unofficial" versions in Portugese, Swahili, Dutch, Pidgin, Italian, and Indonesian, and we suspect that others exist. Such a widespread usage indicates to us the tremendous needs and desires of NGOs in technology and development to have access to an information system which, according to their needs and resources, can help them in internal information management and in participating in exchanges with other institutions.

Access and Exchange of Information

The Annual SATIS List of Publications is a prime feature of this programme, providing development workers with access to 1,200 publications, manuals, and audio-visual materials, on sale at different members of the SATIS network. The AT Publications List, uniquely details materials in seven languages, and has a high proportion of materials created and distributed in the Third World.

The publications list is the first step in a programme aimed at establishing a series of co-publishing activities, mail-order services, and "SATIS bookshops", again with the emphasis on hitherto poorly distributed Third World information. The list is distributed in bulk by several other organizations. Up to now, more than 24,000 copies of this list have been requested, demonstrating the thirst for practical, comprehensive information on the applications of developing technology.

The demand for this sort of information strengthens the case for the projected chain or network of bookshops and mail-order services, on which the initial work is currently under way. It is intended to establish a number of publishing activities combining the proven technical information generated by technology application agencies with the editorial skills and distribution circuits of mass publishing houses. There is a feeling that the demand for information on the application of science and technology in local and national development has scarcely been fulfilled, and the SATIS bookshop programme is intended to respond to these needs.

Inevitably, many of the communities seeking the information are those with difficulties in obtaining the documentation required: often they have limited resources, or problems in transferring scarce foreign currency for purchases, or, as NGOs, they do not qualify for official assistance in the acquisition of information. Thus, SATIS issues guides to the organizations and programmes which can help in financing or providing documentation and other communications materials. Furthermore, the SATIS "token" programme was launched at the end of 1984, to provide a direct service to information seekers; financed by external sponsors and development organizations, tokens are provided to groups with acquisition problems, who can then select and obtain materials up to the value of the available tokens, from any member of the SATIS network.

More detailed access and exchange comes through the SATIS Library Card Catalogs, listing almost 10,000 documents in members' libraries. The documents listed are often unpublished or not generally available works, describing project experiences.

Through this Catalog programme, users can obtain and keep copies of the documents, at low cost. Since the Catalogs are based on a selection of documents by each network member, they provide clear guides and recommendations for the acquisitions of materials. The Catalogs are published annually, and are available, as a complete collection or as a thematic selection, on card; some copies are available in microfiche.

Diffusion, Resource Development, and Appropriate Information Technology

A recurring observation of SATIS members in recent years is that the establishment of networks and procedures, although time-consuming, is a relatively simple affair, relying on a basic desire for co-operation, and technocraft processes. Significantly more difficult is the movement of information beyond the information managers.

Frequently, it has been noted that information libraries, systems, networks is treated as an administrative and supportive service within an organization, and budgetary preference and priority in status is given to the more "exciting" research and development and field application work. This is a prevailing but utterly misguided viewpoint, which effectively stifles any creative and fruitful network. For this reason, SATIS lays great emphasis on helping development technology organizations to treat their information work as an essential part of their executive operations, by stressing that development goals can be achieved only if information resources are mobilized, and not immobilized.

These questions are handled in regional seminars, regularly held in Asia, Latin America and the Caribbean, Africa, and Europe for SATIS members and other groups. These

regional seminars, for exchange of skills and for training, provide a forum for paying attention to methods of communication and technology diffusion, making possible creative exchange between requesters and researchers at all levels. The seminars, and parallel, permanent advisory services, introduce the SATIS information system, and allow for experience to be exchanged on how to identify and assess the information needs of a community, and to package responses so that proposed solutions may be relevant, welcomed, and applied.

Within the programme of providing materials for an essential and proper management of information, attention is being paid to the potential users of computer technology in the work of small development groups. Anxious that this technology should be neither rejected nor applied by an organization without a rational study of its potential, SATIS is co-operating with other development groups to set up an advisory service on the question of if, when, and how to use computer technology in small organizations.

In this context, SATIS has shared in the preparatory work of the INTERDOC programme, in which approximately 40 NGO associations, linking hundreds of NGOs active in various fields of development work, are sharing skills and resources on the use of computer technology as an internal tool and as a communication channel. In this particular attention is being paid to the construction and management of an information network in which computerized and non-computerized "network nodes" can be harmoniously associated.

Resource Guides

This third programme comprises the issue of a series of resource guides, to be complied by members, on resources knowledge, funds, technologies, technologies of use to all development groups, in their own areas of geography and interest. Already, such guides and overviews of appropriate technology activities have been issued, for example, in Cameroon, Peru, Central America, and Netherlands. Additionally, the network as a whole manages a resource reference service, sharing information, often on an informal basis, on recent trends and development in funding, policies, and technologies.

The Organization

It is common sense to say that any network will flourish only if three basic conditions are met:

—the information is sound

—the procedures and protocols for communications (using whatever channels selected) take into account the resources and requirements of participants; and

—the participants are involved in the management and directions of the network.

In the field of (appropriate) technology for development, there have been several initiatives to launch and sustain world-wide information networks: none have come near to fulfilling their admittedly ambitious objectives. The reasons given are many, often the lack of finance. The reasons for the disappointing performance of development technology networks until now have been:

—poor selection, and absences of judgment on the information network;

—opting for exchange procedures which exclude many potential participants on grounds of language (vitally important), funds, and technical equipment;

—inappropriate management structures, which have reduced the centralized networks, which impose a stifling network discipline and preclude expansion, and networks that were inadequately structured on the expectation that information flows and exchanges would take place without any guidance or stimulus.

In designing the structure of SATIS, and in its operational style, great efforts have been made to ensure that the essential basic conditions are met.

The founding members of SATIS have many years' experience in field applications of appropriate science and technology, whether it be an appropriate emerging technology, or a revitalized "traditional" technology. They have the roles of technological research and development, evaluations, referral, information diffusion, and so on, within their own nations, and, frequently, more widely. The countries in which their headquarters are based are: Belgium, Bolivia, Cameroon, Chile, Ecuador, El Salvador, France, Guatemala, India, Indonesia, Ivory Coast, Netherlands, Peru, Philippines, Senegal, Switzerland, Tanzania, United States, West Germany, Zaire, and Zambia. The official languages are Spanish, French, and English. On the question of communication, whilst information technology is rapidly being installed in many members countries, exchanges are currently carried out by visits, staff exchanges, meetings, and correspondence, since these fit the common existing resources.

General policy, programmes, and membership admission are decided by a General Assembly of all members. The next Assembly is scheduled to be held in India. The Assembly elects a representive committee to supervise the execution of the agreed-on work programmes. A secretariat, appointed by the committee, is responsible for the daily execution of the committee's role of fund raising, representation, support to members' information/communication work, and co-ordination of network tasks, many of them decentralized among members. The production of the network newsletter, resource guides, catalogs, and lists, and the organization of members, are typical of these shared tasks. The secretariat will in the near future transfer to a Third World country, reflecting the overall balance of the organization.

Any non-profit group sharing our goals and work can apply for membership: annual fees are currently $US200, plus 5/1000 of the group's budget, if above $US50,000. Constitutionally, at least one-quarter of SATIS's funds must be provided by members; in practice, their share of the budget is higher. In addition, all members make contributions in kind to the network, through their exchanges of resource and information, and through their organizations of seminars. External funds are provided, for general programme and special activity support, by principal United Nations agencies, governments, aid agencies, and associate partners. Intensive links are maintained with many other organizations, at resource-sharing and policy levels: for example, SATIS is a member of the Networking Institute, and of the UNCSTD NGO Advisory Group's Steering Committee.

Member organizations, having decided on the common work programme and being committed to its operation, participate in any or all parts of the programme, according to their special capacities. They have and provide access to the

information and resources of their colleague members. In addition, there is the status of "associate partners" for organizations which are unable to apply for full membership, for legal reasons or because their own technology application work is a relatively small part of their overall programme. In these cases, associate partners choose to make use of and, where possible, provide an information input to some of the network activities, and provide an appropriate financial contribution for these services.

Future Concerns

In 1985, it will be ten years since the first initiatives was taken that led to the widespread activities now undertaken by the SATIS network. In that time, much has changed in broader development thinking: previously marginal viewpoints on the necessity of incorporating appropriate science and technology in development activities are now central in development thinking. That change is reflected, too, in the content, scope, and nature of science and technology education and training, which is now more task-oriented, in the service of development. Relationships are now more complementary involving national governments, government agencies, international agencies, village groups, business groups and NGOs. They can be harmoniously connected in broad structures and programmes of co-operations, whilst respecting and protecting each party position and place.

Above all, information on the practical application of science and technology for development is now better recorded, more accessible, more comprehensive, and more comprehensible. Yet, while the design of a network has become easier as skills and experience have grown in global networking, its functioning remains less than perfect, relying as it does on guarantees for effective participation.

These points apply to any worldwide network on the application of science and technology for development. At that level, and within such a broad framework, such a network is in practice a coalition, or federation, of existing and fixture networks, organized functionally according to the nature of the member organizations, or language, or theme, or geography. As a modest microcosm of such a network, SATIS has developed as an effective network of institutions, with many common concerns, and a desire to strengthen future co-operation. Thus, in the future, the principal points for attention for the further growth of the SATIS network of institutions will include:

—evaluation of the technical quality and applicability of available information in facilitating viable and sustainable development;

—development of skills and capacities in technology assessment, so that networked information can be better selected;

—monitoring of developments in information and communication technology, and experimentation with this technology;

—monitoring of the capacity of development-technology NGOs to use this technology without excessive organizational disruption; and

—operationalization of co-operation links with official development agencies, to optimalize information-sharing for development goals.

ANNEX I

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ANNEX II

List of Abbreviations

The following acronyms are being used in this publication:

ACS	American Chemical Society
AIBA	Agricultural Information Bank for Asia
AGRIS	International Information Systems for the Agricultural Sciences and Technology
AMA	American Medical Association
ARCT	African Regional Centre for Technology
ASEAN	Association of South East Asian Nations
ASFIS	Aquatic Science and Fisheries Information System
ASSET	Abstracts of Selected Solar Energy Technology
ATHIS	Appropriate Technology for Health Information Systems
BNDO	Bureau National des Donnes Oceanique/Documentation Oceanographique
BRS	Bibliography Retrieval Services
CAIRS	Computer Assisted Information Retrieval System
CANOLE	Canadian On-Line Enquiry Service
CARIS	Current Agricultural Research Information Retrieval Systems
CARSTIN	Caribbean Science and Technology Information Network
CCF	Common Communication Format
CEC	Commission of European Communities
CIDIA	Inter-American Centre for Agricultural Documentation
CIS	International Occupational Saftey and Health Information Centre
CLADES	Centro Latino Amaricano de Documentacion Economica y Social
CNMR	Carbon-13 Nuclear Magnetic Resonance Search System
CPS	Corporate Profile System
DEPLADIS	Development Planning Documents Information System
DEVNET	Development Information Network
Dialog	Lockheed Dialog
DIMDI	The German Institute for Medical Documentation and Information
DIS	Development Information Service
ECE	Economic Commission for Europe
ESANET	European Space Agency Network
EURONET	Commission of European Communities Network
FGR	Forest Genetic Resources
FISHDAS	Fisheries Data Base
FORIS	Forest Resources Information System
GDP	Gross Domestic Product
GEMS	Global Environment Monitoring System
HRP	Information Systems of the Special Programme on Research and Training in Human Reproduction
IBEDOC	International Bureau of Education Documentation and Information System
IBINET	Intergovernmental Bureau of Informatics Informatics International Data Network
ICES	International Council for the Exploration of the Sea
IMO	International Maritime Organization
INDIS	Industrial Information System
INFOTERRA	International Referral System for Source of Environmental Information
INIS	International Nuclear Information System
INPADOC	International Patent Documentation Centre
INRES	Information Referral System
INTIB	Industrial and Technological Information Bank
IRPTC	International Register of Potentially Toxic Chemicals
ISBN	International Standard Book Number
ISI-SCI	Institute for Scientific Information
ISIS	Integrated Set of Information Systems
ISO	International Standards Organization
ISS	Information Systems Support
ITC	International Trade Centre
ITU	International Telecommunication Union
LABORDOC	International Labour Documentation
LID	Labour Information Database
LINK	On-Line Information Key

MARC	Machine Readable Catalogue (Library of Congress)
MEDI	Marine Environmental Data Referral System
MISTR	Management Information Systems for Tropical Disease Research
MSSS	Mass Spectral Search System
NASA	National Aeronautical and Space Administration
NRC	National Research Council
OECD	Organization for Economic Co-operation and Development
OPE	Office of Project Execution (UNDP)
PADIS	Pan African Documentation and Information System
PGI	General Information Programme
PIM	Project Institutional Memory
PNDC	Provisional National Defence Council
PTT	Post, Telegraph and Telephone
RCTT	Regional Centre for Technology Transfer
RINSCA	Regional Information in South and Central Asia
RITLA	Red de Información Tecnológica Latino Americana
SDI	Selective Dissemination of Information
SDR	Special Drawing Right
SPINES	Science Policy Information Exchange Systems
STI	Scientific and technological information
TCDC	Technical Co-operation among Developing Countries
TIES	Technological Information Exchange System for Technical Co-operation among Developing Countries
TIPS	Technological Information Pilot System
UNBIS	United Nations Bibliographic Information System
UNISIST	World Information System for Science and Technology
USAID	United States Agency for International Development
VINITI	All-Union Institute for Scientific and Technical Information
WWW	World Weather Watch

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